DOCUMENT RESUME

ED 288 995 CE 048 662

TITLE Missouri Industrial Technology Education Guide.
INSTITUTION Missouri Univ., Columbia. Dept. of Practical Arts and Vocational-Technical Education.
SPONS AGENCY Missouri State Dept. of Elementary and Secondary Education, Jefferson City. Div. of Vocational and Adult Education.
PUB DATE 87
NOTE 320p.
AVAILABLE FROM Instructional Materials Laboratory, 908 Woodson Way, University of Missouri-Columbia, Columbia, MO 65211.
PUB TYPE Guides - Non-Classroom Use (055)

EDRS PRICE MF01/PC13 Plus Postage.
DESCRIPTORS Classroom Techniques; Ethics; *Industrial Arts; *Industrial Education; Industry; Professional Development; Program Administration; *Program Development; Program Evaluation; Program Guides; *Program Implementation; Records (Forms); Secondary Education; State Standards; *Statewide Planning; Student Evaluation; Student Organizations; Teacher Certification; Teacher Evaluation; *Teacher Improvement; Teacher Responsibility; Teaching Methods; Technical Education; Technological Literacy; Technology
IDENTIFIERS *Missouri

ABSTRACT

This guide is intended to serve as Missouri's primary resource for planning, implementing, and evaluating industrial technology/industrial arts education. The following topics are covered: selecting a direction for industrial technology education (ITE) (its underlying philosophy, mission, goals); planning an ITE program (recommended scope and sequence for ITE, recommended courses for ITE, revision or updating of existing programs, steps in starting a new program, procedures for documenting the curriculum); implementing an ITE program (following current trends in ITE, updating existing facilities, planning new facilities, equipping an ITE program, maintaining laboratory equipment, implementing a safety program, informing key constituents); teaching ITE (planning instruction, selecting instructional materials, meeting individual and special needs, providing for equity, incorporating student organization activities, teaching employability skills); organizing and managing an ITE program (gaining access to key resource personnel, using advisory committees, organizing and managing ITE), evaluating ITE (evaluating program, student, and teacher performance); meeting professional responsibilities (ethics, pre- and inservice education, professional involvement); and using resources (the Missouri Industrial Technology Education Standards, the Missouri ITE Guide, recommended competencies for core courses). (MN)

ED288995

Missouri
Industrial Technology
Education

GUIDE

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

● Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

M Dyrenfurth

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

CE 048 662

How can this guide help me?

If you want to:	Turn to chapter
Update ITE's direction • Philosophy • Goals	1
Plan ITE • Scope & Sequence • Programs, courses • Lessons, modules, objectives	2
Implement ITE • Update facilities • Plan new facilities • Equip & maintain labs • Enhance safety • Improve public relations	3
Teach ITE • Improve instruction • Enhance equity • Meet special needs • Initiate student organizations	4
Organize and manage ITE • Access key resource people • Find & use support services • Use advisory committees • Manage the program	5
Evaluate ITE • Evaluate the program • Test students • Assess teacher performance	6
Meet professional responsibilities • Review ethics • Secure preservice & inservice education • Get certification information	7
Find key resources • Forms • Missouri ITE Standards • Course competencies	8

BEST COPY AVAILABLE

Missouri

Industrial Technology Education Guide

Steering Committee

Mr. Donald Bradshaw, President
Industrial Technology Education
Association of Missouri

Dr. Herman Collins, Professor
Northwest Missouri State University

Mrs. Teresa Dean, President
Missouri Congress of Parents
& Teachers

Mrs. Martha Eddlemon, President
Missouri School Counselor
Association

Mr. Dwight Hart, IA Chairman
Hazelwood Central High School

Dr. Charles Keseman, Professor
Central Missouri State University

Mr. Dean Proffit, Representative
Missouri School Boards Association

Dr. Ahmed Sabie, IA Supervisor
St. Louis Board of Education

Mr. Dick Smith, Representative
Missouri Association of Secondary
School Principals

Mr. John Stamm, Section Chief
Engineering Services, AT&T

Dr. Irwin Thomas, Representative
Missouri Association of
School Administrators

Review Panel

Jim Baxter
Hannibal High School

Pete Brown
K.C. Technical Education Center

Gerald Bussen
Hazelwood Central High School

Robert Cox
Southeast Missouri State University

Leon Devlin
Northeast Missouri State University

Eldon Divine
The School of the Ozarks

Gary Elmore
Independence Public Schools

David French
St. Louis, MO

Bill Fuemmeler
Boonville High School

Foster Fuller
Lincoln University

Marvin Hiley
Gallatin High School

Ken Holmes
Lee's Summit High School

James Kyd
South Callaway School District

Frank Logan
O'Fallon Technical Center

James Lund
Santa Fe R-10 High School

Donald Marquardt
Hickman High School

Dan McMillan
Plato High School

Norman Peterson
University of Missouri-Columbia

Dennis Meyer
Poplar Bluff Senior High School

Mitch Ridgeway
Mexico Senior High School

Art Rosser
Central Missouri State University

Eugene Sherrell
Southwest Missouri State University

Dennis Sutton
Missouri Southern State College

Ken Wilkinson
St. Joseph Central High School

Ben Yates
Hickman High School

Project Director:
Michael J. Dyrenfurth, Professor
Industrial Education

Project Researcher:
David Baird

Department of Practical Arts & Vocational Technical Education
College of Education
University of Missouri-Columbia

Project Monitor:
Mr. Stephen D. Coffman
Industrial Technology Education Supervisor
Division of Vocational and Adult Education
Missouri Department of Elementary
and Secondary Education

Available from:
Instructional Materials Laboratory, 908 Woodson-Way
University of Missouri-Columbia, Columbia, Missouri 65211
Phone (314) 882-2883, in Missouri (800) 392-7217

How can this guide help me?

If you want to:	Turn to chapter
Update ITE's direction • Philosophy • Goals	1
Plan ITE • Scope & Sequence • Programs, courses • Lessons, modules, objectives	2
Implement ITE • Update facilities • Plan new facilities • Equip & maintain labs • Enhance safety • Improve public relations	3
Teach ITE • Improve instruction • Enhance equity • Meet special needs • Initiate student organizations	4
Organize and manage ITE • Access key resource people • Find & use support services • Use advisory committees • Manage the program	5
Evaluate ITE • Evaluate the program • Test students • Assess teacher performance	6
Meet professional responsibilities • Review ethics • Secure preservice & inservice education • Get certification information	7
Find key resources • Forms • Missouri ITE Standards • Course competencies	8

Acknowledgements

First and foremost, this Guide is a tribute to professionalism, to the faith and dedication of Missouri's Industrial Technology (Industrial Arts) education profession -- its individuals and its association -- the Missouri Industrial Technology Education Association. These colleagues knew there was a better way! This document represents the successful completion of a major step in their quest to improve the technological education of Missouri's youth.

But professions are not anonymous groups of people. Instead they are comprised of many individuals who give up untold amounts of their time and energy. Clearly the members of the project's steering committee, as named on the frontispiece, are prime examples of such dedication. In many ways this Guide is more a product of their insights than those of the project writers. Most valuable also were the perspectives of the key associated groups who served on the project's steering committee. The representatives of Missouri's school board, school administrator, secondary principal, guidance counselor, and parent-teacher associations genuinely helped in developing a product designed to help all involved in the schooling of our youth. Similarly, the members of the project's review panel made significant contributions by helping insure that the Guide's recommendations were, above all, feasible for implementation in Missouri's varied school settings.

These professionals worked in an environment created by the field's associations. The Industrial Arts Division of the AVA, the International Technology Education Association, and the Missouri Industrial Technology Education Association have collectively created a nation- and state-wide climate of recognition that our profession's charge is to develop the industrial and technological understanding and capability of our students. Without their leadership, and the contributions and insights of such people as Niel Edmunds, Donald Bradshaw, and Kendall Starkweather, many parts of this project would have been much more difficult if not actually impossible.

Then too, the Guide includes much of the good practice taught by the teacher educators in Missouri's universities and colleges. Therefore appreciation is extended to my present and former colleagues, at UMC and at each of the other institutions, for their willingness to share their work.

The development team also wishes to acknowledge the cooperation and contributions of many colleagues in other states. After all, this Guide represents a compilation of the best thinking of the profession, regardless where it is found. As such, inputs from Arizona, Georgia, Illinois, Iowa, Nebraska, New Jersey, North Dakota, Texas, Utah, Virginia and Wisconsin publications and supervisors were significant contributions and the development team expresses its appreciation for them. Also appreciatively acknowledged is the work of the team that developed Missouri's previous Industrial Arts Handbook. Similarly, Prakken Publications; David Thompson of Brodhead-Garrett; Georganna Beachboard and Dick Omer, both of MDESE; UMC's Instructional Materials Laboratory; Missouri LINC; and Dr. Scott Bradley provided insight and written sections that were invaluable to our efforts. Without the contributions of all of these colleagues, as well as those of some whom space precluded from direct mention, this Guide certainly would not have been successfully completed.

Stephen Coffman, the state's new Industrial Technology (Industrial Arts) Education supervisor deserves special acknowledgement and credit for this Guide. His initiative in securing funding, his careful monitoring, and his vision in establishing a long range plan for the state's support of industrial technology education made much progress possible. Similarly David Baird's reliable support, insightful writing, and constructive interaction made essential contributions to the overall success of the Guide.

Special recognition must also be awarded to Cheryl Perne. Without Cheryl's enthusiastic contributions to the project's operation and her tireless work in entering and word processing countless revisions this Guide simply would not have reached print.

To all of the above, and to the many others unnamed because of space limitations, the project director, on behalf of Missouri's Industrial Technology Education profession, appreciatively acknowledges his debt.

Michael J. Dyrenfurth
June 1987

Foreword

This Guide is dedicated to the improvement of Industrial Technology Education in Missouri and to all of the dedicated instructors who work hard at this challenge each day! As such, this Guide:

- is intended to be the state's primary resource for planning, implementing and evaluating industrial technology/industrial arts education,
- is further intended to provide guidelines for organizing, instructing, and managing such programs, and
- is also designed to help direct industrial technology educators to references where they can find additional information.

The Guide should meet the needs of teachers and administrators by presenting highlights of the best thinking and practice. With the talents and efforts of Missouri's many practitioners, and the suggestions contained in this Guide, we look forward to the creation of a broad base of exemplary programs that will help Missouri's youth learn much about their technological world!

Table of Contents

Chapter I: A Direction for Industrial Technology Education (ITE)....1

1. **Philosophy of ITE........1**
   - Technology and Industry........1
   - Social Context........1
   - Implications For Education........2
   - ITE's Relationship to Vocational and General Education........2
   - The Profession's Name........2
   - Content........3
2. **Mission and Goals of ITE........5**
3. **Resources........9**

Chapter II: Planning the ITE Program........1

1. **Introduction........1**
2. **Recommended Scope and Sequence for ITE........3**
   - Explanation of Scope and Sequence Levels........3
   - Characteristics of Quality Scope & Sequence Statements........5
3. **Recommended Courses for ITE........7**
   - Level I: Awareness Courses........7
   - Level II: Foundation Building Courses........7
   - Level III: Initial and Intermediate Cluster Competency Mastery Courses........9
   - • Technology Specialization I Courses........9
   - • Technology Specialization II Courses........9
     - - Materials & Processing Cluster Courses........9
     - - Energy & Power Cluster Courses........10
     - - Communication Cluster Courses........11
   - Level IV: Analysis and Synthesis Courses........12
   - Recommended ITE Course Outlines and Competencies........13
   - • Introduction to Technology/Industrial Technology........13
   - • Exploration of Technology/Industrial Technology........14
   - • Introduction to Communication Technology........16
   - • Introduction to Energy & Power Technology........17
   - • Introduction to Materials & Processing Technology........19
4. **Revising/Updating Existing Programs........21**
5. **Starting a New ITE Program........23**

6. Documenting the Curriculum ... 25
Curriculum Components ... 25
Instructional Management Systems ... 65
Continuum of Objectives ... 25
Course of Study ... 30
Major Units of Instruction ... 34
Self-Instructional Modules ... 39
Lesson Plans ... 50
Performance Objectives ... 65

7. Resources ... 69

Chapter III: Implementing the ITE Program ... 1

1. Introduction ... 1
Trends in ITE Facility Design and Equipment ... 1
Types of Industrial Technology Education Facilities ... 2
- Comprehensive Laboratories ... 2
- Cluster Laboratories ... 2
- Technological Specialization (Unit) Laboratories ... 2

2. Updating Existing Facilities ... 3
Reorganization ... 3
Renovation ... 4
Space Management ... 5

3. Planning New Facilities ... 11
Overview of the Process ... 11
- Phase One ... 11
- Phase Two ... 11

Determining Design Criteria ... 11
Educational Specifications ... 11
Space Needs ... 14
Auxiliary Spaces ... 19
Space Relationships ... 19
Interaction with the Architect ... 21
Equipment Layout ... 21
Construction ... 21
Acquisition of Equipment and Materials ... 23
Installation of Equipment ... 23
Evaluation and Modification of Equipment and Facilities ... 25
Sources of Funds ... 25
Sample Facility Designs ... 25

4. Equipping the Program ... 33
The Purchasing Process ... 33
Budgeting ... 33
Donations ... 33
Writing Specifications ... 34
- The Role of the Instructor ... 34
- The Role of the Administrator ... 35
- The Role of the Supply Company (Vendor) ... 35
- Common Problems ... 35

5. Maintaining Laboratory Equipment **37**

6. Implementing a Safety Program **39**
Introduction 39
Instruction 40
- Content & Organization 41
- Suggested Instructional Techniques 41

Evaluation 42
Record Keeping 44
Accident Reports 44
Treatment of Injuries 45
Inspections 45
Organization and Approval of the Overall Safety Program 49
- Format 49
- Approval Procedures 49

Instructor Liability 50

7. Informing Key Constituents (Public Relations) **51**

8. Resources **53**

Chapter IV: Teaching ITE **1**

1. Introduction **1**

2. Planning Instruction **3**
A Sampling of Methods 5
- Field Trips 5
- Guest Speakers 5
- Student Personnel System 5
- Interviews 5
- Bulletin Board 5
- Class Discussion 6
- Role Playing 6
- Group Project 6
- Conceptual Learning 6
- Enterprise 6
- Cooperative Work Study 6
- Seminar 6
- Individualized Instruction 7

3. Selecting Instructional Methods **11**

4. Meeting Individual and Special Needs **13**
Identifying Special Needs Learners 13
Learner Characteristics 13
- Disadvantaged 13
- Limited English Proficiency (LEP) 14
- Gifted and Talented 14
- Handicapped 14

Accommodating Special Needs Students in the ITE Program 16

5. Providing for Equity **17**

6. **Incorporating Student Organization Activities** 19

7. **Teaching Employability Skills** 21

8. **Resources** 25

Chapter V: Organizing and Managing the ITE Program 1

1. **Introduction** 1

2. **Accessing Key Resource Personnel** 3

3. **Using Available Support Systems** 9
   Missouri Department of Elementary and Secondary Education 9
   Special Needs Support 9
   Guidance Support 9
   Computer Networking 9
   Accessing Audio-Visual Aids 10
   Securing Donations and Surplus 10
   Curriculum Support 11

4. **Using Advisory Committees** 13
   National Technology Education Advisory Council 13
   Local ITE Advisory Committees 13
   Local ITE Advisory Committee Membership 14
   Local ITE Advisory Committee Operations 15
   - Selection of Officers 15
   - Officer Duties 15
   - Meetings 15
   - The School's Responsibility to Committee Members 15

5. **Organizing and Managing ITE** 17
   Managing Student Performance Records 17
   Managing Field Trips 17
   Inventorying Equipment and Tools 17
   Managing Supplies 19

6. **Resources** 21

Chapter VI: Evaluating ITE 1

1. **Introduction** 1

2. **Evaluating the ITE Program** 3
   - Overview 3
     - Local (Internal) Evaluation 3
     - School Accreditation 3
     - State (DESE) Evaluation 4
   - Local Evaluation 7
   - Keying to State Goals and Competencies 11
   - Follow-up Evaluations 11
   - Missouri School Classification and Accreditation 14
     - I. Standards to be met by all classified and accredited school districts 14
     - II. Standards to be met by all classified and accredited middle/junior high schools 14
     - III. Standards to be met by all classified and accredited high schools 15

3. **Evaluating Student Performance** 19
   - Purposes for Student Evaluation 19
   - Pretesting 19
   - Evaluation Techniques 20
     - Progress Charts 20
     - Self- or Progress Checks 20
     - Rating Scales 20
     - Achievement Tests 20
     - Oral Tests/Questioning 21
   - Improving Written Tests 24
   - Grading 24

4. **Evaluating ITE Teacher Effectiveness** 27
   - Performance Based Evaluation 29

5. **Resources** 37

Chapter VII: Meeting Professional Responsibilities 1

1. **Introduction** 1

2. **Addressing Professional Responsibilities** 3
   - Responsibilities 3
   - Ethics 6

3. **Securing Preservice Preparation and Teacher Certification** 11

4. **Using Available In-service Education** 13

5. **Increasing Professional Involvement** 15

6. **Resources** 17

Chapter VIII: Helpful Resources 1

1. **Introduction** 1

2. **Forms** 3

3. **Missouri Industrial Technology Education Standards** 5
   Topic 1. Philosophy 5
   Topic 2. Instructional Program 7
   Topic 3. Student Populations Served 9
   Topic 4. Instructional Staff 10
   Topic 5. Administration and Supervision 12
   Topic 6. Support Systems 14
   Topic 7. Instructional Strategies 16
   Topic 8. Public Relations 18
   Topic 9. Safety and Health 19
   Topic 10. Evaluation Process 22
   Developing the Overall Profile 23
   Identifying Means to Correct Deficiencies 23

4. **Recommended Competencies for ITE Core Courses** 27
   Introduction to Technology/Industrial Technology 28
   Exploration of Technology/Industrial Technology 32
   Introduction to Communication Technology 37
   Introduction to Energy & Power Technology 43
   Introduction to Materials & Processing Technology 49

5. **Missouri ITE Guide Suggested Revision Form** 57

List of Figures

Chapter 1: A Direction for Industrial Technology Education

Figure I-1: Relationship of Technology to Industrial Technology 3
Figure I-2: Educational Goals for the State of Missouri 6
Figure I-3: Missouri Industrial Technology Education Program Goals 7

Chapter II: Planning the ITE Program

Figure II-1: ITE's Scope and Sequence: Essential Program Components 4
Figure II-2: High School Curriculum Options for Offering Level III ITE Cluster Courses 6
Figure II-3: Recommended ITE Courses by Levels 8
Figure II-4: Steps in Implementing New programs 24
Figure II-5: Steps in Documenting a Curriculum 26
Figure II-6: Component Parts of an IMS 27
Figure II-7: The Continuum of Objectives 28
Figure II-8: Components of a Course of Study 30
Figure II-9: Course of Study: Quality Checksheet 33
Figure II-10: Sample Major Unit of Instruction Format 36

Chapter II: Planning the ITE Program, continued

Figure II-11: Major Unit Overview Sheet 37
Figure II-12: Major Unit of Instruction: Quality Checksheet 38
Figure II-13: Self-Instructional Module Components 39
Figure II-14: Sample Self-Instructional Module Format 42
Figure II-15: Sample Lesson Plan Format (Detailed) 51
Figure II-16: Sample Lesson Plan Format (Simplified) 58
Figure II-17: Sample Information Lesson Plan Format 62
Figure II-18: Sample Demonstration Lesson Plan Format 63
Figure II-19: Lesson Plan: Quality Checksheet 64
Figure II-20: Cognitive, Affective & Psychomotor Domains of Educational Outcomes 66
Figure II-21: Performance Objective: Quality Checksheet 68

Chapter III: Implementing the ITE Program

Figure III-1: Updated Industrial Technology Education Laboratory 6
Figure III-2: Technology Education Laboratory, Pittsburg Middle School, Pittsburg, Kansas 7
Figure III-3: Renovated ITE Laboratory 9
Figure III-4: Educational Specifications Overview 12
Figure III-5: Educational Specifications Outline 13
Figure III-6: Space Relationship Chart 20
Figure III-7: Sample Laboratory Equipment Layout 22
Figure III-8: Sample Equipment Record Card 24
Figure III-9: Sample JHS or Small SHS ITE Facility 26
Figure III-10: Wood River JHS, Hailey, Idaho 27
Figure III-11: Sample SHS ITE Facility (North Dakota) 28
Figure III-12: Sample SHS ITE Facility--Wedge Shaped, (Wisconsin) 29
Figure III-13: Model Cluster-Based ITE Facility 30
Figure III-14: Sample SHS ITE Facility--Rectangular (Wisconsin) 31
Figure III-15: Sample Critical Incident Technique Safety Rating Format 43
Figure III-16: Student Accident Report Form 47
Figure III-17: Safety Inspection Checklist (Sample Page) 48
Figure III-18: Public Relations Analysis Matrix 52

Chapter IV: Teaching Industrial Technology Education

Figure IV-1: Overview of Instructional Strategies 4
Figure IV-2: Blair's Principles of Learning 5
Figure IV-3: Tischler's Thoughts on Learning 7
Figure IV-4: Guidelines for the Selection of Delivery Systems 12
Figure IV-5: Equity Strategies for Classroom Teachers 18
Figure IV-6: Goals & Objectives of the Missouri ITE Students Association 20
Figure IV-7: Employability Competency Profile 23

Chapter V: Organizing and Managing ITE Programs

Figure V-1: ITE Inventory Form 18
Figure V-2: Material Use Record 19
Figure V-3: Materials Inventory System 20

Chapter VI: Evaluating ITE

Figure VI-1: Evaluative Criteria from the NSSE: Technology Education (Industrial Arts), Sixth Edition (sample page) 5
Figure VI-2: Standards and Evaluation Criteria for Industrial Arts Programs (Public & Private 7-12) from MO DESE (Sample Page) 6
Figure VI-3: Local Evaluation System Procedures.....9
Figure VI-4: Suggested Local ITE Evaluation Report Format.....10
Figure VI-5: Program Follow-up Form.....13
Figure VI-6: Basic Curriculum Requirements for Missouri Classification.....17
Figure VI-7: Sample Rating Scale.....22
Figure VI-8: Affective Performance Objective Format.....23
Figure VI-9: Simulated Record of Scores and Grading System.....26
Figure VI-I0: Lesson Presentation Evaluation Sheet.....28
Figure VI-11: 19 Suggested Criteria for Performance-Based Teacher Evaluation.....30
Figure VI-12: Pre-Observation Worksheet.....31
Figure VI-13: Formative Observation Form.....32
Figure VI-14: Job Target Sheet.....33
Figure VI-15: Summative Evaluation Report.....34

Chapter VII: Meeting Professional Responsibilities

Figure VII-1: Individual and Organizational Rights and Responsibilities in the Education of Children (PTA).....5
Figure VII-2: NEA Code of Ethics of the Education Profession 7
Figure VII-3: MSTA Code of Professional Ethics.....9
Figure VII-4: Missouri Industrial Arts Teacher Certification Minimums.....12
Figure VII-5: Selected Professional Associations 16

Chapter VIII: Helpful Resources

Figure VIII-1: Forms Index.....3
Figure VIII-2: ITE Program: Overall Quality Profile 24
Figure VIII-3: Deficiency Correction Report 25

List of Tables

Chapter III: Implementing the ITE Programs

Table III-1: Space Recommendations for ITE Facilities: Grades 7-8 15
Table III-2: Space Recommendations for ITE Facilities: Grades 9-12.....17

Chapter V: Organizing and Managing the ITE Program

Table V-1: Missouri Universities with ITE Programs.....4
Table V-2: Selected Trade Associations Relevant to ITE 5
Table V-3: Useful Federal & State Agencies.....6
Table V-4: Professional Associations Relevant to ITE.....8

Chapter I

A Direction for Industrial Technology Education

1. Philosophy of ITE

Missouri's Industrial Technology Education/Industrial Arts profession affirms that industrial technology education programs should teach about industrial technology and that they should do so **in a way that serves as a vehicle to build understanding, skills, and attitudes that can be generalized and applied in other technologies.** Furthermore, because all people are affected by technology, and because of technology's increasing presence in our lives, it was concluded that a minimum of one semester-long course experience in industrial technology education is recommended for all of Missouri's middle school, junior high and high school youth.

Technology and Industry

But what is technology? Simply stated it is humankind's use of tools, machines, materials, processes and energy to satisfy its wants and needs. As such, it is not the search for an explanation of why things work -- that is science. Nor is technology merely applied science -- because often it precedes scientific knowledge.

Technology is knowing "how" to do something with tools, machines, materials processes and energy -- and then it necessarily involves being able to do. Mere knowledge is not sufficient. Rather, technology is a combination of knowledge, skills and attitude that is always more powerful than any single faceted competency.

Industry is one of humankind's basic institutions. As such, it parallels that of government, church, and education. It is that institution that supplies our civilization with goods and services to fill our wants and needs. It does so by using technology. The technology used by industry, is typically referred to as Industrial Technology.

Social Context

Contemporary and future society are clearly different from what America experienced during its first industrial revolution. To be sure, some elements of the industrial revolution remain, but many more have changed. Technology as a force has affected most aspects of our life, and thus technology seems to be the single most distinctive characteristic that sets today and the future apart from our past.

Evidence of this is seen in the literature. Note, for example, the frequent references to the *post-industrial* society, to the demise/reduction of *smoke stack* industry and to the *information* society. Furthermore, we have seen tangible evidence of such shifts in our automotive, steel, petroleum and electronics industries.

Business and industry have been required to grapple with technology engendered issues such as productivity, technological capability and global competitiveness. Their workers have been challenged to retrain to develop currently marketable skills -- in cognitive, affective and psychomotor domains -- in order to maintain their ability to support themselves and contribute to our free-enterprise economy. Furthermore, given technology's advances, America's workers find these skills to be constantly changing.

Legislators have also been pressed to understand technology and its effects as they work to frame policies for the public good. With the rampant escalation of both the amount and complexity of technology, it is increasingly difficult for people to exercise appropriate citizenship functions, particularly given the curtain of confusion raised by technology and its media offspring.

Consequently, citizens have often found themselves bewildered by increasingly complex consumer decisions. Frequently they face decisions involving trade-offs between immediate gain for long-range unknowns or even known, but preferably ignored, negative consequences, e.g. the effects of toxic wastes. Similarly, recreational environments and activities have increasing technological components, as do personal and societal learning activities.

Technology's pervasive influence has permeated even our homes. Our lifestyle is timed, microwaved, accelerated, recorded, computerized and confounded. A greater proportion of people are working, families are resorting to schedules to program their contact and others are unemployed due to technological advances. Outside knowledge is pouring into the home via television and other media. Not infrequently the tensions from external aspects of life, many of which are technologically induced, do come home in the form of stress.

Even in social service arenas such as the health sciences, technological capabilities have caused us to ponder when enough is enough. We ask, for example, to what end do we operate life support systems in situations currently deemed hopeless?

Implications for Education

Given the pervasive nature of technology, the industrial arts/technology education profession raises the question: ***"Where do people develop the understanding, skills and attitudes to deal with forces such as technology?"*** This guide's response is straightforward. Clearly our society uses formal schooling as a principal method to this end -- at least for youth, and in increasing numbers, for adults.

It follows then that one must ask, ***"What are the schools doing to help youth and adults address technology's challenges?"*** What systematic efforts are in place to develop technologically appropriate understanding, skills, and attitudes in elementary, secondary, postsecondary, adult and continuing education?

This guide presents an overview of how Missouri addresses this responsibility -- directly, efficiently, and effectively through its ITE program! To this end, the Missouri Industrial Technology Education Guide is intended to be the state's primary resource for planning, implementing and evaluating Industrial Technology Education/Industrial Arts. Therefore it provides guidelines for the organization, instruction and management of ITE programs. The Guide also directs industrial technology/industrial arts educators to references where they can find additional information. The Guide was developed to meet the needs of teachers and administrators by presenting highlights of the best thinking and practice supportive of efforts to create exemplary programs that help Missouri's youth learn about their technological world.

ITE's Relationship to Vocational and General Education

Given the context described in the previous sections, it is clear that ITE must be an essential component of BOTH general education and vocational (specialized) education. Only in this way can Industrial Technology Education:

1. Serve as the component of general education that develops generalizable understandings, capabilities, values and attitudes related to industrial technology in all youth.

2. Serve as a component of specialized education that contributes to meaningful occupational choice and/or preparation in a technological society.

The Profession's Name

Industrial arts educators have, since at least 1904, addressed the content of industry. Given the fact that industry uses technology to attain its goals, it follows that industrial art's content must be derived from industrial technology. Therefore, if the industrial arts' content derives from industrial technology, why not its name? Other disciplines such as mathematics, science and language arts take their names from their content -- why not ours?

This guide is dedicated to helping Missouri's industrial arts programs reflect industry, technology and professional practice with greater fidelity. Consequently, it incorporates the profession's recommendation that its new name, ***industrial technology education,*** be used to symbolize this.

The term "Industrial Technology" can be used in two contexts. When used with education, as in Industrial Technology Education, the term refers to the ITE/IA program and to the profession that teaches it. When used by itself, IT refers to the content (skills, knowledge, and attitudes) used by industry. Obviously, ITE programs develop student understandings of, and capability with, a sample of this content.

Content

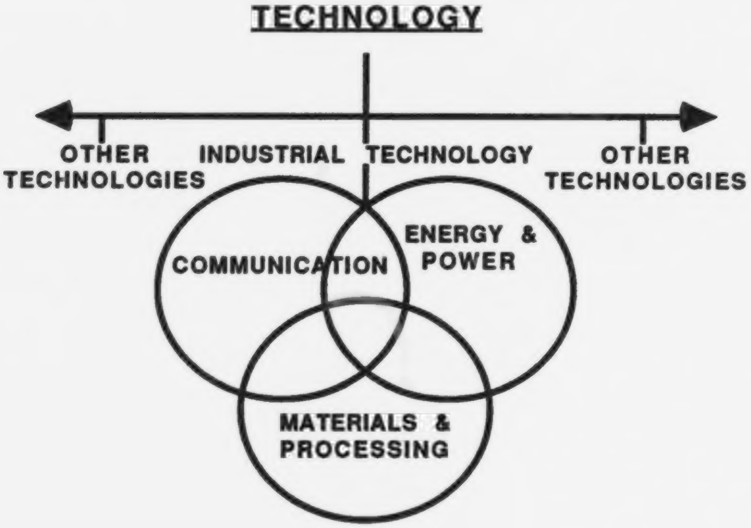
Although in our material and technological society not everyone is a producer, all are consumers and users of the products of industry and its technology. Therefore, **industrial technology education** as a school program draws its content from industry and the technology industry uses to achieve its ends. Content is also selected by identifying the competencies individuals need to effectively use the products of a technological society.

Given the preceding philosophy and foundation, it is clear that the educational program known as **industrial technology education** derives its content, i.e. the subject matter it teaches, from industry and technology. More specifically, this program focuses on the technology which industry uses to accomplish its ends. Obviously, this content is called industrial technology. It often is considered to be a body of knowledge or a discipline. As such, industrial technology is a subset of technology as shown by Figure I-1 and much of it can be generalized to technology. Note that:

1. Industrial technology is that technology which is used by industry. As such, industrial technology coexists with agricultural and other technologies.
2. Industrial technology consists of three clusters; Materials & Processing, Energy & Power, and Communication.

Figure I-1

Relationship of Technology to Industrial Technology



Notes:

2. Mission and Goals of ITE

Since industry and technology are distinctive characteristics of the American culture, and since one of the key purposes of education is to transmit the culture to future generations, it follows that it is necessary for the schools to provide youth with an insight into, an understanding of, and selected capabilities with, the technological nature of this society. Industry and technology spring from the human ability to reason, solve problems, create, construct, and use materials, tools, machines and processes imaginatively. Because these abilities are an integral part of our technological culture they should be developed in all students -- regardless of their educational goals or occupational aspirations.

The overarching mission of industrial technology education as a school program is to develop the human potential of all students for responsible work, citizenship and leisure roles in a technological society. As such, ITE operates within the context established by the Missouri State Board of Education's statement of educational goals, highlights of which are shown in Figure I-2. To accomplish ITE's designated educational roles, industrial technology education programs must systematically address each of its three primary missions, namely to:

1. Develop each person's **ability to comprehend and apply** the concepts of industrial and technological systems.

2. Develop each person's **values and attitudes** related to the appropriate use of industrial technology -- its tools, machines, materials, processes and products.

3. Develop each person's **ability to use** materials, technological processes and hardware to achieve constructive work skills and enhance occupational opportunity.

ITE addresses these three primary missions by purposefully working towards an important set of goals. Simply put, this means that every student participating in any implementation of the industrial technology education program should experience a systematically designed program of instruction and activity that accomplishes each of the 15 goals presented in Figure I-3.

Figure I-2

Educational Goals for the State of Missouri[1]

It is the belief of the State Board of Education that one of the fundamental rights of each individual is the right of equal access to educational opportunity--regardless of race, creed, or socioeconomic status.... The product of such a system must be an individual who is adequately prepared to enter the next sequential phase of life--one who can readily adapt in a dynamic and rapidly changing society .... Although these goals are categorized for convenience, a single category or combination of categories should not be interpreted to be mutually exclusive ....

I. Intellectual Development

It is the goal of the State Board of Education that each individual will have the opportunity to develop his/her intellectual ability to the extent of his/her developmental capacity. The development of intellectual ability should include not only the acquisition of knowledge, but also the creative ability to process and use that knowledge so that each individual becomes a literate and worthwhile member of society.

The State Board of Education believes that each individual must become proficient in communication, quantitative thinking, social processes, scientific understanding, decision making, and aesthetic appreciation in order to acquire the desired knowledge and fundamental intellectual processes.

• • •

II. Physical Development

It is the goal of the State Board of Education that each individual will have the opportunity to develop knowledge, understanding, and/or skills in the processes of physical growth and maturation, health and recreation to the extent of his/her developmental ability.

• • •

III. Social Development

It is the goal of the State Board of Education that each individual will have the opportunity to develop social skills to the extent of his/her developmental ability. These skills should be related to the individual's physical and social environment, cultural awareness, governmental institutions avocational pursuits, and concept of self, morality and values.

• • •

IV. Career Development

It is the goal of the State Board of Education that each individual be provided with systematic and sequential activities at all levels to facilitate educational-occupational decision making appropriate to his/her state of maturation. These activities should be related to the social significance of work, occupational exploration, occupational preparation, and adult occupational education.

• • •

---

[1] ________. Educational Goals for the State of Missouri. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, n.d., pp. vi-ix.

Figure I-3

Missouri Industrial Technology Education Program Goals

Every student participating in any implementation of industrial technology education will experience a systematically designed and delivered program of instruction and activity that:

1. Develops an understanding of, and capability with, industrial technology -- its processes, materials, equipment and products.
2. Develops an understanding of the practical applications of mathematic, scientific and technological principles to industrial processes.
3. Develops basic skills in the safe use of tools, machines and processes used by industry and technology.
4. Develops technological problem-solving skills and attitudes.
5. Fosters creativity in using technology for desirable purposes by encouraging students to create, from materials and with technological processes and hardware, new and different forms which have greater or alternative value.
6. Contributes to meaningful occupational choice by developing an understanding of industrial and technological career opportunities and their requirements.
7. Facilitates the discovery of individual talents, aptitudes, interests and potentials related to industry and technology through laboratory activity.
8. Encourages cooperative attitudes, constructive work habits and other traits that will help secure and maintain employment.
9. Engenders pride in work done well.
10. Develops consumer skills related to the appropriate production, consumption and maintenance of technological goods and services.
11. Reinforces general education's basic skills, and contributes to advanced education, by providing practical and motivating applications of basic knowledge, attitudes and skills.
12. Prepares for entrance into advanced secondary and post-secondary vocational/technical programs by promoting the development of a basic foundation of occupational skills and interests.
13. Provides an alternative learning mode for those who learn better in settings other than the conventional classroom.
14. Encourages the development of attitudes reinforcing the free enterprise system.
15. Stimulates leadership behavior by student organization activity.

Notes:

3. Resources

________. A Rationale for Industrial Technology. Denton, TX: Texas Education Agency, 1984.

________. Educational Goals for the State of Missouri. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, n.d.

________. Handbook for Industrial Arts Education. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, 1977 [IA-2-1].

________. Handbook for Vocational Education. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, Division of Career and Adult Education, 1981.

________. Program Directions for Occupational Education in New York State. Albany, NY: New York State Education Department, 1984.

________. Technology Education: A Modern Focus for Industrial Arts Curriculum Report. Reston, VA: American Industrial Arts Association, 1985.

________. Technology Education: A Perspective on Implementation. Reston, VA: American Industrial Arts Association, 1985.

________. Technology Education: Preparing Youth for a Technological World. Reston, VA: American Industrial Arts Association, n.d.

Dyrenfurth, Michael J. Industrial Arts in Missouri: Its Objectives, Conditions and Concerns. St. Charles, MO: Industrial Arts Association of Missouri, March 17, 1984.

Dyrenfurth, Michael J. Literacy for a Technological World. Information Series No. 266. Columbus, OH: National Center for Research in Vocational Education, The Ohio State University, 1984.

Dyrenfurth, Michael J. et al. To build a future. . . . Missouri Industrial Arts Study Project Report. Columbia, MO: University of Missouri-Columbia, Department of Practical Arts and Vocational-Technical Education, 1986.

Hales, J. Industrial Arts: A Means of Preparing Youth to Contribute to our Industrial-Technological Society. Reston, VA: American Industrial Arts Association, 1980.

Hales, J. & Snyder, James F. (Eds.). Jackson's Mill Industrial Arts Curriculum Theory. Charleston, WV: West Virginia Department of Education, 1981.

McCrory, David L. & Bame, E. Allen. "Technology Education: A New Direction for Industrial Arts at the Middle Level." Schools in the Middle: A Report on Trends and Practices. January 1986.

Pedrotti, Leno S. Preparing for Tomorrow's Technologies. Presentation to Missouri Council of Vocational Administrators, Fall Leadership Conference, Lake Ozark, Missouri. Waco, TX: Center for Occupational Research and Development, 1985.

Notes:

Chapter II

Planning the ITE Program

1. Introduction

Chapter I described the challenges facing our profession and it provided a foundation upon which the profession can build as Missouri moves to reshape its industrial arts program into an ITE program that better meets student needs in this and future times. This chapter provides guidance in how to plan the needed reshaping.

As such, it is important to note the guiding principles for such reshaping, as established by Missouri's ITE/IA teachers, teacher educators, the Industrial Arts Study Project and the state's supervisor for industrial arts. These principles state:

- Existing programs offer much that can be built upon to create a better future.
- It is better to evolve than to make a drastic change.
- We do not need to scrap everything in our current Industrial Arts programs in order to adapt to the demands of our technological world.
- The recommended ITE program can be offered in existing (but updated) industrial arts facilities and by existing (but responsive) industrial arts teachers.

Notes:

2. Recommended Scope and Sequence for ITE

A detailed study of Missouri's Industrial Arts programs and state and national trends was conducted during 1985-86 (Dyrenfurth, 1986). This project yielded a scope and sequence for industrial technology education that was **responsive** to the technological and societal demands of our world. The scope and sequence reflects the profession's "state-of-the-art" in programming and it does so in a way that is **feasible** given Missouri's wide range of school sizes and environments. The recommended scope and sequence is shown in Figure II-1.

Explanation of Scope and Sequence Levels

1. Missouri's industrial technology education program, structured as shown in Figure II-1, is carefully designed to follow the natural pattern of student development. It does this by guiding students through a series of courses that follow the stages of Awareness, Foundation Building, Initial and Intermediate Cluster Mastery, and Analysis & Synthesis.

2. Level I promotes technological awareness by infusing a set of technology-based learning activities into the regular ongoing elementary school curriculum. These activities should be designed to enhance mathematics, science and social studies curricula with practical technology-oriented applications. One or more of the school's or system's ITE teachers should be assigned, for a specific number of periods, to serve as resource person(s) to support this infusion.

3. Level II builds an understanding of technology by means of one or more, Introduction to Technology/ Industrial Technology courses. It is recommended that this course be required of ALL students in each of Missouri's school systems. The course needs to be a minimum of a semester in length and it must involve a systematic overview of the most important tools, machines, materials and processes of industrial technology. This course must sample the key elements of each technological cluster and it must not focus on any single cluster. Where interest and/or enrollment warrants, this course may be repeated at higher grade levels, and students may enroll again in subsequent years. This course is intended to serve as a prerequisite to all other industrial technology education courses.

4. Level III builds on the understanding of technology developed in Level II by moving into initial and intermediate competency mastery in each cluster. These clusters are:

   - Materials & Processing Technology. Study of this cluster involves the tools, machines, materials and processes involved in manufacturing, constructing and/or servicing goods. Typically it focuses on metallic, organic (woods and plastics) and ceramic materials.

   - Communication Technology. Study of this cluster involves the tools, machines materials and processes involved in transferring ideas and information from one place to another. As such, it involves all combinations of human -- machine communication. Typically it focuses on electronic communication, graphic arts, engineering graphics and photography.

   - Energy & Power Technology. Study of this cluster involves the tools, machines, materials and processes involved in converting energy, transferring power and instrumenting and controlling such processes. Typically it focuses on electricity/electronics, computers, engines and motors, instrumentation and control systems.

   Level III can be implemented using several different curriculum patterns. As shown in Figure II-2, one or more separate courses in each technology cluster or one course spanning all three technological clusters and entitled Exploration of Technology/Industrial Technology may be offered. To achieve the goals of Level III, it is recommended that if multiple courses within any single technology cluster are offered, they must include a prerequisite quarter or semester course spanning the breadth of that cluster. Subsequent courses within the cluster may reflect any appropriate subset of that technology. As shown in Figure II-2, after taking the first course in any cluster, students may:

   a. Take any second level course in that cluster
   b. Take the first course in any other cluster
   c. Advance to take any Analysis & Synthesis course.

Figure II-1

Industrial Technology Education's Scope & Sequence: Essential Program Components

Grade	Level	Course	Logic
10-12	IV Analysis & Synthesis	Any analysis and synthesis course	One of these courses
			↑ And ↑
9-12	III Initial and Intermediate Cluster Competency Mastery	Intro. to Communication Technology Intro. to Materials & Processing Technology Introduction to Energy & Power Technology	All of these courses
			↑ Or ↑
		Exploration of Technology/Industrial Technology	This course
			↑ And ↑
6-9	II Foundation Building	Introduction to Technology/Industrial Technology	This course is the minimum required in a program
K-6	I Awareness	Elementary School Technology Education Infusion Activities	Recommended but optional

5. A complete industrial technology education program must offer one or more courses at the Analysis & Synthesis level (Level IV). These are designed to build analytical, synthesis and higher order thinking skills. For example, a Research and Development course might investigate the nature of metallic, synthetic and organic materials and testing procedures. Students could also apply previously learned capabilities to the challenges of our free enterprise system. In such a course, students could design a product or service, establish and finance a company, produce the product or service and then market it. Alternatively, courses at this level could be designed to build in-depth knowledge for a vocational or pre-technical preparation.

6. Level III's Technology Specialization courses in each clusters, as shown in Figure II-2, may also be taught at the Analysis & Synthesis level at local option. These specialization courses are the ones after the initial cluster survey.

Characteristics of Quality Scope & Sequence Statements

To maximize the quality of ITE programs, it is recommended that each school establish its own scope and sequence. Furthermore, each local scope and sequence should be carefully designed to be compatible with the design principles listed previously. In doing so, the school needs to consider its overall enrollment, level of support and the nature of its community and industry. As a minimum, however, every industrial technology education program must include the components shown in Figure II-1.

1. To be complete, it is suggested that each local scope and sequence should document:

   - The course names and content that comprise the program
   - The pattern of student flow through these courses (show prerequisites)
   - The range of grade levels at which each course is offered.
   - Which students are to be served.
   - The interface between the ITE program and other curriculum areas.

2. The scope and sequence for industrial technology education is built from a list of courses provided in part 3 of this chapter.

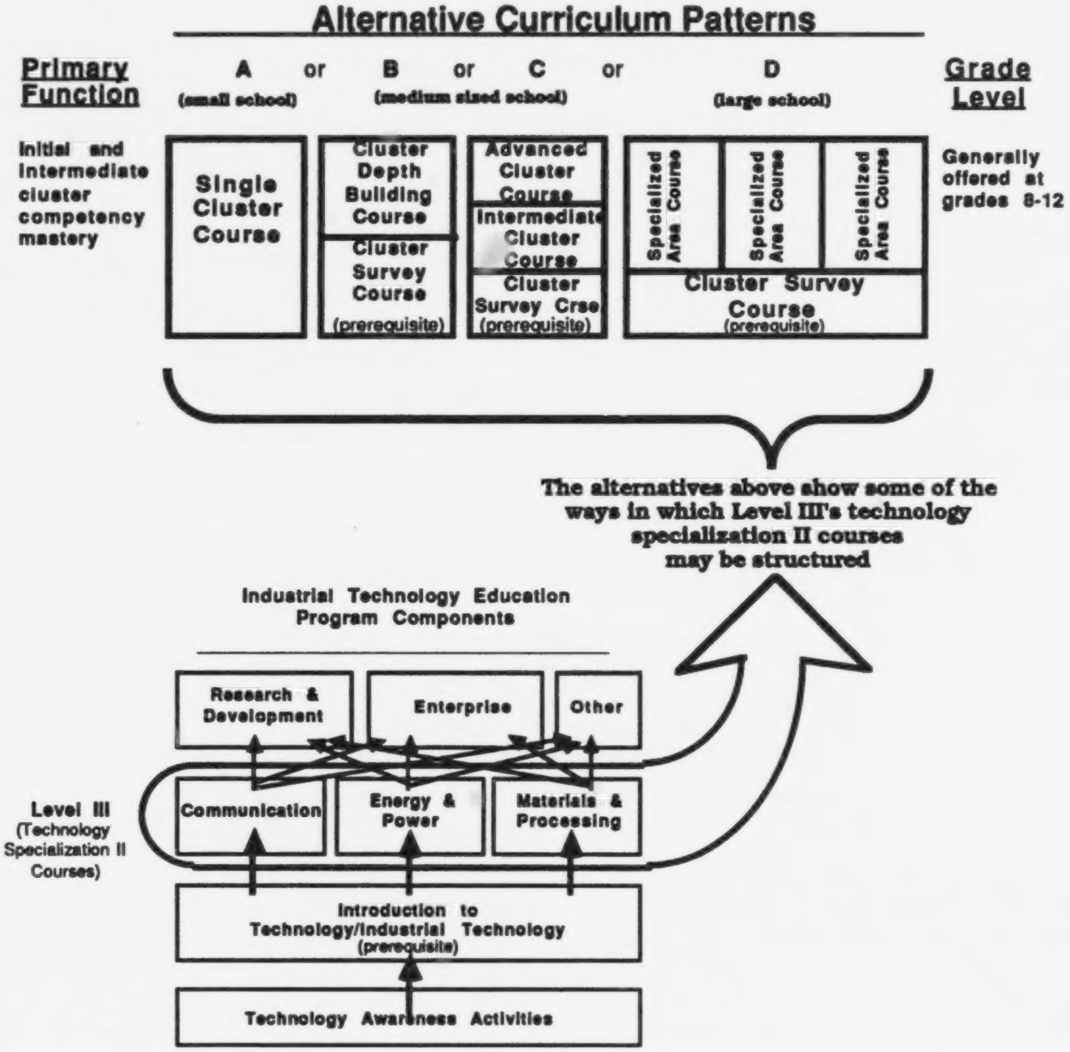
3. For each industrial technology education course, regardless of content, focus or level, instructors should develop a systematic plan to address the interface between the content and objectives of that course and those of:

   - Mathematics
   - Science
   - Social Studies
   - Oral and written communication
   - Careers in the field
   - Other areas such as computer technology

4. Quality ITE program scope and sequence statements will systematically incorporate careful articulation plans and agreements that facilitate student movement to: advanced educational opportunities offered by vocational, technical or college institutions; the world of work; and/or other opportunities such as entrepreneurship. The articulation plan shows how the program contributes to, and articulates with, advanced colleges, vocational, technical and post-secondary educational opportunities as well as to the world of work.

Figure II-2

High School Curriculum Options for Offering Level III Industrial Technology Education Cluster Courses


Alternative Curriculum Patterns
Primary Function
A or B or C or D
(small school)
(medium sized school)
(large school)
Grade Level
Initial and intermediate cluster competency mastery
Single Cluster Course
Cluster Depth Building Course
Cluster Survey Course (prerequisite)
Advanced Cluster Course
Intermediate Cluster Course
Cluster Survey Crse (prerequisite)
Specialized Area Course
Specialized Area Course
Specialized Area Course
Cluster Survey Course (prerequisite)
Generally offered at grades 8-12
The alternatives above show some of the ways in which Level III's technology specialization II courses may be structured
Industrial Technology Education Program Components
Research & Development
Enterprise
Other
Communication
Energy & Power
Materials & Processing
Level III (Technology Specialization II Courses)
Introduction to Technology/Industrial Technology (prerequisite)
Technology Awareness Activities

3. Recommended Courses for ITE

An entire spectrum of courses is available to implement the ITE program according to the recommended scope and sequence. Officially they are listed in Missouri's Guide to . . . C&D Report as issued by DESE. Their essence is summarized here. Note that this list is only a recommendation. Where local planning develops an alternative course that good reason and professional judgement suggests implements the scope and sequence better, it may be offered. This option is particularly useful -- even encouraged, to tailor offerings to specialized student objectives and/or to special local industry/technology situations. Additionally, each of the recommended courses in Level II and III may be tailored to suit the needs of any specific age/student group or grade, 6 - 12, and Level III courses may also be taught as Level IV courses with appropriate changes in their instructional approach. The overall pattern of courses by levels is graphically summarized in Figure II-3.

Level I: Awareness Courses

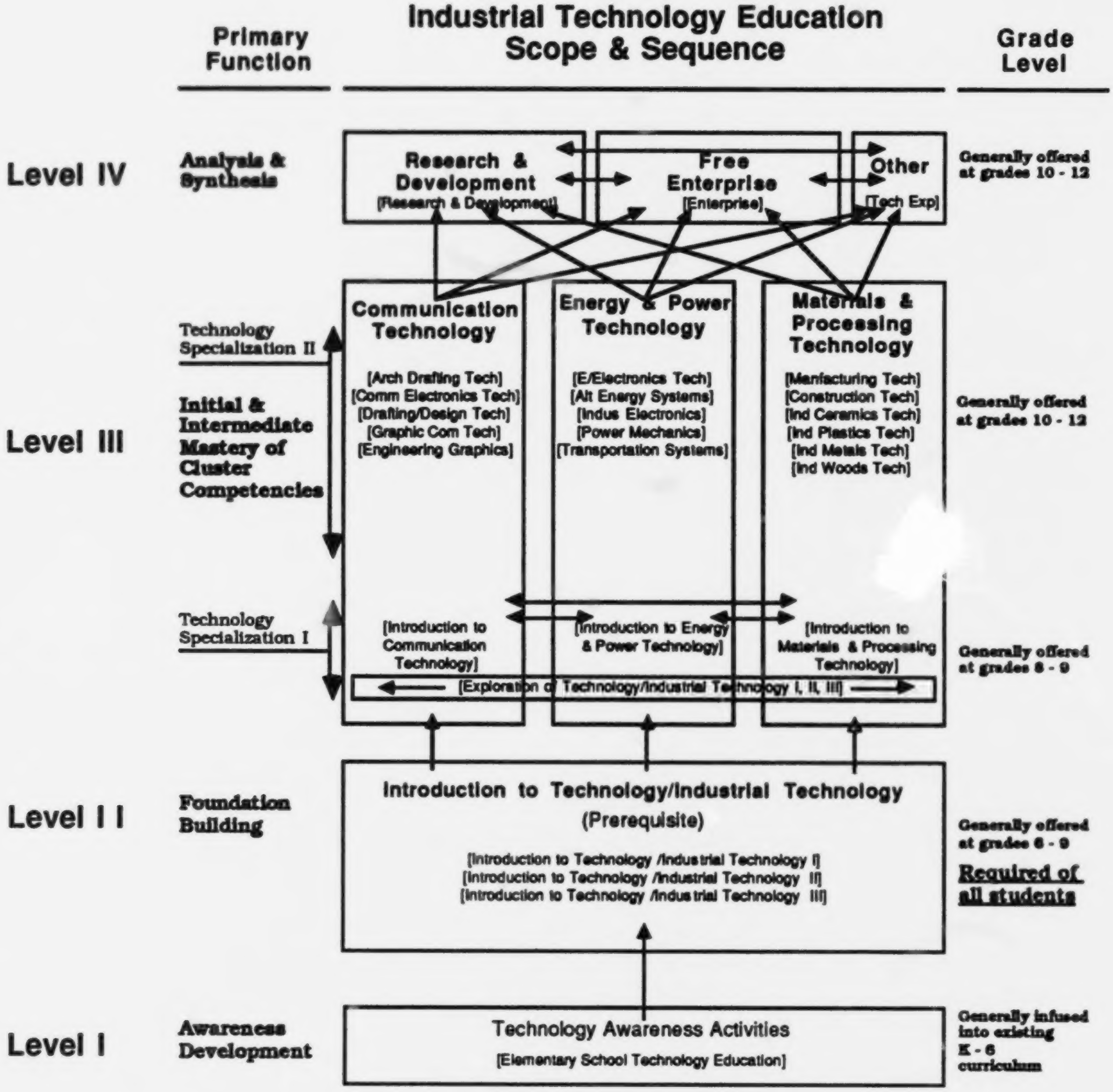
• Elementary School Technology Education ELEM TE, IA C & D 105400 Grades K-6	This course develops an initial awareness of the technological world. It provides opportunities for exploring, manipulating and planning with tools, materials and processes by using technological activities that also reinforce basic mathematics, science and social studies skills.

Level II: Foundation Building Courses

• Introduction to Technology/Industrial Technology I, II, III INTRO TECH I C & D 105405 Grades 6-9	This course develops a foundation of technological understanding and capability that provides an overview upon which future courses can build. Students systematically survey energy & power, materials & processing and communications technology with demonstrations and practical activities that develop understanding, attitude, skill and problem-solving capability.

Figure II-3

Recommended Industrial Technology Education Courses by Levels


Primary Function
Industrial Technology Education Scope & Sequence
Grade Level
Level IV
Analysis & Synthesis
Research & Development
[Research & Development]
Free Enterprise
[Enterprise]
Other
[Tech Exp]
Generally offered at grades 10 - 12
Technology Specialization II
Level III
Initial & Intermediate Mastery of Cluster Competencies
Communication Technology
[Arch Drafting Tech]
[Comm Electronics Tech]
[Drafting/Design Tech]
[Graphic Com Tech]
[Engineering Graphics]
Energy & Power Technology
[E/Electronics Tech]
[Alt Energy Systems]
[Indus Electronics]
[Power Mechanics]
[Transportation Systems]
Materials & Processing Technology
[Manfacturing Tech]
[Construction Tech]
[Ind Ceramics Tech]
[Ind Plastics Tech]
[Ind Metals Tech]
[Ind Woods Tech]
Generally offered at grades 10 - 12
Technology Specialization I
[Introduction to Communication Technology]
[Introduction to Energy & Power Technology]
[Introduction to Materials & Processing Technology]
[Exploration of Technology/Industrial Technology I, II, III]
Generally offered at grades 8 - 9
Level II
Foundation Building
Introduction to Technology/Industrial Technology
(Prerequisite)
[Introduction to Technology /Industrial Technology I]
[Introduction to Technology /Industrial Technology II]
[Introduction to Technology /Industrial Technology III]
Generally offered at grades 6 - 9
Required of all students
Level I
Awareness Development
Technology Awareness Activities
[Elementary School Technology Education]
Generally infused into existing K - 6 curriculum

Level III: Initial and Intermediate Cluster Competency Mastery Courses

Technology Specialization I Courses

• Exploration of Technology/ Industrial Technology EXPLORE IND TECH C & D 105450 Grades 8-12	An exploration of industrial technology's three clusters (energy & power, materials & processes, communications) that builds depth and breadth The emphasis is on increased capability with a greater variety of tools, materials, processes, career awareness and reinforcement of basic skills/core competencies.
• Introduction to Communication Technology COMM TECH C & D 105435 Grades 9-12	Students develop communication technology capabilities through activities with graphic arts, photography, electronic communication, drafting (CAD) and design, media and information storage and retrieval. Emphasis is placed on developing understanding of the concepts that underlie each application.
• Introduction to Energy & Power Technology ENRG-PW TECH C & D 105410 Grades 9-12	Students develop energy & power technology capabilities through activities with energy, power, instrumentation, control, electricity/electronics, transportation, conservation, hydraulics and pneumatics. Emphasis is placed on developing understanding of the scientific principles that underlie each application.
• Introduction to Materials & Processing Technology MTRL PROC TECH C & D 105420 Grades 9-12	Through manufacturing and construction activities students study the production of products using metal, ceramic, synthetic, and organic (Eg. woods) materials. Experiences also involve management, research, development, marketing and servicing as used by industries providing goods, services and structures.

Technology Specialization II Courses

These courses help students build depth in each of the designated clusters of technology. They offer specializations within a cluster as indicated by their name. Examples include but are not limited to, the following:

- Ceramics, woods, metals or plastics
- Robotics, machine control
- Digital electronics
- Engine technology
- Alternative energy technology
- Microprocessor technology
- CAD/CAM
- Engineering graphics

Materials & Processing Cluster Courses

• Manufacturing Technology MANFAC TECH C & D 105423 Grades 10-12	A study of material processes (separating, combining, forming, conditioning and finishing) in conjunction with the managed sequence of activities used to convert an idea into a useful manufactured product or service.

• Construction Technology CONSTR TECH C & D 105424 Grades 10-12	A study of the designing, planning and constructing of a structure on-site. Emphasis will be on pre-construction, construction and post-construction processes from management through actual construction.
• Industrial Ceramics Technology IN CER TECH C & D 105421 Grades 10-12	A study of the tools, materials and industrial processes involved in the manufacturing of products made from nonmetallic resources such as rocks, clay, glass and sand including the industrial ceramic products.
• Industrial Plastics Technology IND PL TECH C & D 195422 Grades 10-12	A study of the operations involved in the manufacture and transformation of synthetics (plastics) into usable products with special emphasis placed on technical information, qualities, specifications and standards. Learning experiences include experimenting, creating, designing, fabricating, forming and evaluating plastic products.
• Industrial Metals Technology MET TECH C & D 105470 Grades 10-12	Study of the operations involved in the transformation of metal into usable products with special emphasis placed on technical information, qualities, specifications and standards. Activities include experimenting, creating, designing, constructing and evaluating metal products in foundry, welding, sheet metal, machine metal areas and automated and/or computerized manufacturing.
• Industrial Woods Technology WOOD TECH C & D 105482 Grades 10-12	A study of the woods/cellulose manufacturing industry, the construction of buildings and the production of articles made from wood and cellulosic products. Learning experiences include experimenting, designing, constructing, operating and evaluating industrial tools, processes, forest products, related synthetic materials, cabinetmaking, woods machining and finishing.

Energy & Power Cluster Courses

• Electricity/Electronics Technology E/ELTRN C & D 105440 Grades 10-12	A study of the sources, measurements, control and applications of electrical energy in devices such as those used in heating, power, illumination, communications such as the telegraph, telephone, radio, television, radar and computers. Learning activities include experimenting with designing, constructing and testing electrical devices.
• Alternate Energy Systems ALT ENERGY C & D 105413 Grades 10-12	A survey of wind, biomass, solar, geothermal and other nontraditional energy sources, characteristics and applications by means of project and hands-on activity.

• Industrial Electronics Technology INDUS ELTRN C & D 105442 Grades 10-12	Study of electronic circuits as applied to the control of industrial equipment and processes, applications of semiconductors, photoelectric devices, relays, servomechanisms and electronic heating, together with digital principles and applications. Activities include experiments and practical project work.
• Power Mechanics Technology POWER MECH C & D 105411 Grades 10-12	A study of the development, transmission and utilization of power including the theory, related physical and chemical principles, maintenance and servicing of machines. Activities involve the operating principles, design, assembly, maintenance and repair of engines and similar power sources.
• Transportation Systems TRANS SYS C & D 105414 Grades 10-12	A study of various transportation systems for materials and people. Trains, cars, boats, airplanes, pipelines and conveyors are sample systems used in the hands-on activities.

Communication Cluster Courses

• Architectural Drafting Technology ARCH DRAFT C & D 105431 Grades 10-12	Communicating, through lines and symbols, information about buildings. Activities involve preliminary sketches, plans, models, elevations, sections, detail drawings, the study of architectural design, history of structures, building ordinances, building materials and processes, and computer-aided drafting.
• Communications Electronics Technology COMM ELTRN C & D 105441 Grades 10-12	A detailed foundation of theoretical knowledge, instrumentation and practical application of electronics used in the communications industry. Instruction and hands-on work includes power, supplies, amplifiers, oscillators, transmitters, receivers, electromagnetic radiation and semiconductors.
• Drafting & Design Technology DR-DGE TECH C & D 105430 Grades 10-12	Communication of ideas through drawings, sketches, charts, graphs and maps. Develops skills through freehand, instrument and computer drawing involved in lettering, sketching and dimensioning; geometric construction, orthographic and pictorial drawing; auxiliary, section and working drawings.
• Graphic Communications Technology GR CM TECH C & D 105490 Grades 10-12	A study of the tools, materials and processes involved in the mass production of communication by means of photography and printing such as intaglio, relief, planographic, screen process printing and thermography. Learning activities include using cameras, developing negatives and making contact prints, enlargements, mountings, composition, imposition, presswork and bindery.

• Engineering Graphics Technology EN-GRAPHIC C & D 105433 Grades 10-12	A study of the graphic solution to space problems and of the communication of mechanical designs through lines, symbols and drawings. The course involves working drawings, orthographic projection, pictorial views and assembly drawings used in areas such as production, computer-aided drafting, and manufacturing.

Level IV: Analysis and Synthesis Courses

• Research and Development ITE R & D C & D 105406 Grades 10-12	Targeted on developing technological analysis and synthesis skills, this course allows students to pursue relevant technological problems. Considerable independent work is involved in investigating the theory and practice of a significant facet of technology.
• Technology Experimentation TECH EXPER C & D 105407 Grades 10-12	Students experiment, research and develop any single facet of technology in any cluster. Based on structured problem-solving and design, this course is designed to investigate technology's interface to mathematics and science in meeting our needs.
• Enterprise ENTERP C & D 105408 Grades 10-12	This course involves student establishment and operation of a manufacturing, construction or service enterprise.
• Other Industrial Technology/Industrial Arts C & D 105499 O IND ARTS	Included are other organized subject matter content and learning situations in industrial technology/industrial arts education which are not included in any of the other course descriptions.

Recommended ITE Course Outlines and Competencies

This initial list of the key competencies to be developed by each of the five basic courses in the ITE scope & sequence is provided in Chapter VIII's part 4. Each of these courses, has competencies presented in groups suggested by major units of instruction as shown below. Some important content topics within each major unit are also provided for overview purposes. These lists do not imply a sequence for instruction other than what is inherent in the content itself. **Instructors may well wish to reorganize the competencies into different units if it is appropriate to their course goals.** Since the implementation of these courses will vary in length, content may be added/substituted as long as the intent of the course, within the scope & sequence, is maintained.

Introduction to Technology/Industrial Technology

Suggested Content Outline

1. Working With Technology
    - Information Accessing/Retrieval
    - Information Processing
    - Information Storage
    - Systems Analysis
    - Systems Design

Suggested Major Units of Instruction:

1. Working With Technology
2. Overview of Technology
3. Communication Technology
4. Energy & Power Technology
5. Materials & Processing Technology
6. Leadership Roles in Technology

Suggested Content Outline

1. Working With Technology
    - Information Accessing/Retrieval
    - Information Processing
    - Information Storage
    - Systems Analysis
    - Systems Design
    - Measurement, Precision and Standardization

2. Overview of Technology
    - Technology Outside of Industry
        - Medical
        - Military
        - Recreational
        - Agricultural
    - Components of Industrial Technology
        - Energy & Power Technology
        - Communication Technology
        - Materials & Processing Technology
    - Impacts of Technology
        - Environmental
        - Psychological
        - Sociological
        - Economic
    - Evolution of Technology
    - Relationship between Technology & Science
    - Relationship between Technology & Industrial Technology
    - Innovation and Invention
    - Technology Assessment
    - Technology Forecasting
    - Careers
    - Safety

3. Communications Technology
    - Communications Fundamentals
    - Engineering Graphics/Drafting
    - Graphic Arts
    - Photographic Communication
    - Design
    - Electronic Communication
    - Applications (Desktop publishing, CAD, satellite, printing, photography, video-recording. . .)

4. Energy & Power Technology
    - E & P Fundamentals
    - Energy Systems
    - Power Systems
    - Transportation Systems
    - Instrumentation & Control Systems
    - Electric/Electronic Systems
    - Applications (Engines, robots, space travel, computers, electronics. . .)

5. Materials & Processing Technology
    - M & P Technology Fundamentals
    - Manufacturing
    - Construction
    - Materials Science
    - Enterprise and Entrepreneurship
    - Labor and Management
    - Applications (Mass production, residential construction, materials testing. . .)

6. Leadership Roles in Technology
    - Individual Leadership
    - Group Leadership
    - Student Organization Activities

Exploration of Technology/Industrial Technology

Suggested Content Outline

1. Overview of Industrial Technology
    - Energy & Power Technology
    - Materials & Processing Technology
    - Communication Technology
    - Scientific Foundations of Technology
        - Energy Conservation
        - Molecular Structure of Materials
        - Nature of Electricity
        - Light
        - Time
        - Sound
        - Thermal Expansion
        - Scientific Notation
    - Industrial Technology Systems
        - Relationships of Industrial Technology to Technology
        - Interrelationships among M & P, Communication, and E & P Technologies

Suggested Major Units of Instruction:

1. Overview of Industrial Technology
2. Technological Procedures
3. Exploring Communication Technology
4. Exploring Energy & Power Technology
5. Exploring Materials & Processing Technology
6. Technology and Careers
7. Leadership Roles in Technology

2. Technological Procedures
    - Information Accessing/Retrieval
    - Information Processing
    - Data Analysis
    - Graphing Data
    - Information Storage
    - Black Box Approach
    - Brainstorming
    - Systems Analysis
    - System Design
    - Using Computers to Calculate
    - Data Acquisition
    - Group Methods of Problem-Solving

3. Exploring Communication Technology
    - Reinforcement of Fundamentals
    - Drafting
    - Photography
    - Electronic Communication
    - Graphic Arts
    - Applications -(Computer messaging, telephone, satellite communications, video-recording, photography, desktop publishing, CAD...)

4. Exploring Energy & Power Technology
    - Reinforcement of Fundamentals
    - Instrumentation & Control Systems
    - Applications (Power transmission, energy conversion. . .)
    - Transportation Systems

5. Exploring Materials & Processing Technology
    - Reinforcement of Fundamentals
    - Manufacturing
    - Construction
    - Materials Science
    - Applications (Mass production, Materials processing, materials testing. . .)

6. Technology and Careers
    - Career and Technology Clusters
    - Elements of Career Choice
    - Preparing for a Career

7. Leadership Roles in Technology
    - Individual Leadership
    - Group Leadership
    - Student Association Activities

Introduction to Communication Technology

Suggested Content Outline

1. Communication Technology Overview
   - Communication Process
   - Communication Systems
     - Man <---> Machine
     - Machine<---> Machine
   - Components of Communication Systems
   - Languages & Symbols of Communication
   - Interface to Energy & Power Technology
   - Interface to Materials & Processing Technology
   - Communication Technology Impacts
     - Economic
     - Environmental
     - Psychological
     - Sociological
   - Safety
   - Scientific Foundations of Communication Technology
     - Chemistry
     - Physics
     - Math

2. Technological Procedures
   - Information Accessing/Retrieval/Storage
   - Information Processing
   - Information Reporting
   - Problem-solving Processes
   - Systems Analysis & Design
   - Technology Assessment

3. Communication Technology Fundamentals
   - Idea Generation
   - Image Generation
   - Image Processing
   - Transmission
     - Light
     - Audio
     - Electrical
     - Electronic
     - Graphic
     - Tactile

   - Reception/Decoding
   - Feedback & Evaluation
   - Information Storage Methods
   - Data Communications

4. Engineering Graphics & Design Fundamentals
   - Drafting Techniques
   - Standards & Symbols
   - Basic Descriptive Geometry
   - CAD
   - Architectural Drafting
   - Mechanical Drafting
   - Design
   - Print Reading
   - Sketching
   - Print Reproduction

Suggested Major Units of Instruction:

1. Communication Technology Overview
2. Technological Procedures
3. Communication Technology Fundamentals
4. Engineering Graphics & Design Fundamentals
5. Graphic Communications (Print) Fundamentals
6. Photographic Communication Fundamentals
7. Electronic Communication Fundamentals
8. Communication Technology Applications
9. Careers in Communication Technology
10. Leadership Roles in Technology

5. Graphic Communications (Print) Fundamentals
    - Graphic Arts
    - Copy generation
    - Printing
    - Binding and Finishing

6. Photographic Communication Fundamentals
    - Exposing Film
    - Processing Techniques
    - Line Copy
    - Continuous Tone Copy
    - Color/BW

7. Electronic Communication Fundamentals
    - Radio Frequency
    - Data Communications
    - Computer Graphics
    - Laser/Fiber Optics

8. Communication Technology Applications
    - Broadcasting
        - Radio
        - Television
    - Newspaper & Magazine (Print) Publishing
    - Desktop Publishing
    - Video Recording
    - Satellite

9. Careers in Communication Technology
    - Personal Assessment
    - Career and Technological Trends
        - Manufacturing
        - Service
        - Sales
    - Employability Skills

10. Leadership Roles in Technology
    - Individual Leadership
    - Group Leadership
    - Student Organization Activities

Introduction to Energy & Power Technology

Suggested Content Outline

1. Energy & Power Technology Overview
    - Energy & Power Systems
    - Components of Energy & Power Technology Systems
    - Interface to Communication Technology
    - Interface to Materials & Processing Technology
    - Energy & Power Technology Impacts
        - Economic
        - Environmental
        - Psychological
        - Sociological
    - Safety

Suggested Major Units of Instruction:

1. Energy & Power Technology Overview
2. Technological Procedures
3. Energy Technology Fundamentals
4. Power Technology Fundamentals
5. Electricity/Electronics Fundamentals
6. Instrumentation & Control Technology Fundamentals
7. Energy & Power Technology Applications
8. Careers in Energy & Power Technology
9. Leadership Roles in Technology

- Scientific Foundations of Energy & Power Technology
  - Chemistry
  - Physics
  - Math
  - Basic Machines

2. Technological Procedures
   - Information Accessing/Retrieval/Storage
   - Information Processing
   - Information Reporting
   - Problem-solving Processes
   - Systems Analysis & Design
   - Technology Assessment

3. Energy Technology Fundamentals
   - Measurement
   - Energy Sources
     - Chemical
     - Mechanical/Kinetic
     - Radiant
     - Electrical
     - Thermal
     - Nuclear
   - Energy Conversions
   - Renewable/Non-renewable
   - Alternative Energy Systems

4. Power Technology Fundamentals
   - Types of Power Transmission
     - Pneumatic
     - Hydraulic
     - Mechanical
     - Electrical
   - Measurement
   - Power Conversion

5. Electricity/Electronics Fundamentals
   - Electricity Fundamentals
   - Electronic Fundamentals
   - Electricity/Electronics Components
   - Circuits
   - Electricity/Electronics Measurement

6. Instrumentation & Control Technology Fundamentals
   - Components
     - Computers
     - Sensors
     - Transducers
     - Regulators
     - Indicators
   - Types of Instrumentation & Control Systems
     - Fluid
     - Optical
     - Mechanical
     - Electrical
     - Electronic
     - Electro/Mechanical

7. Energy & Power Technology Applications
    - Robots
    - Materials Handling
    - Transportation
        - Terrestrial
        - Air
        - Water
        - Space
    - Equipment Operation
    - Engines
    - Power Distribution
    - Servicing

8. Careers in Energy & Power Technology
    - Personal Assessment
    - Career and Technological Trends
        - Manufacturing
        - Service
        - Sales
    - Employability Skills

9. Leadership Roles in Technology
    - Individual Leadership
    - Group Leadership
    - Student Organization Activities

Introduction to Materials & Processing Technology

Suggested Content Outline

1. Materials & Processing Technology Overview
    - Materials & Processing Systems
    - Components of Materials & Processing Systems
        - Materials
        - Manufacturing
        - Construction
    - Interface to Communication Technology
    - Interface to Energy & Power Technology
    - Materials & Processing Technology Impacts
        - Economic
        - Psychological
        - Sociological
        - Environmental
    - Types of Materials & Processing Production
        - Artistic
        - Individual
        - Job
        - Mass
        - Continuous
    - Safety
    - Scientific Foundations of Materials & Processing Technology
        - Chemistry
        - Physics
        - Math

2. Technological Procedures
    - Information Accessing/Retrieval/Storage
    - Information Processing
    - Information Reporting
    - Problem-solving Processes

Suggested Major Units of Instruction:

1. Materials & Processing Technology Overview
2. Technological Procedures
3. Materials Technology Fundamentals
4. Construction Technology Fundamentals
5. Production Technology Fundamentals
6. Materials & Processing Technology Applications
7. Careers in Materials & Processing Technology
8. Leadership Roles in Technology

- Systems Analysis & Designs
- Technology Assessment

3. Materials Technology Fundamentals
   - Properties & Characteristics
   - Destructive Testing
   - Non-destructive Testing
   - Inspection and Measurement
   - Classification of Materials
     - Organic -- (Adhesives, woods, paper, plastic, rubber. . .)
     - Metallic -- (Ferrous, non-ferrous. . .)
     - Synthetic -- (Plastics, composites. . .)
     - Ceramic -- (Glass, abrasives, cements/concretes. . .)

4. Construction Technology Fundamentals
   - Types of Construction
   - Site Preparation
   - Types of Structures
   - Construction Methods
   - Erection
   - Materials
   - Servicing

5. Production Technology Fundamentals
   - Tools & Machines
   - Tooling
   - Processing
     - Separating
     - Combining
     - Forming
     - Conditioning
   - Pre-processing/Extraction
   - Post-processing/servicing
   - Labor Relations
   - Management
   - Financing/Enterprise
   - Marketing
   - Research & Development

6. Materials & Processing Technology Applications
   - Residential Construction
   - Mass Production
   - Craft Production
   - Quality Control

7. Careers in Materials & Processing Technology
   - Personal Assessment
   - Career and Technological Trends
     - Manufacturing/Construction
     - Service
     - Sales
   - Employability Skills

8. Leadership Roles in Technology
   - Individual Leadership
   - Group Leadership
   - Student Organization Activities

4. Revising/Updating Existing Programs

Most readers will already be operating an industrial technology education/industrial arts program. Many will be doing so in aging facilities. Some even with aging curricula. However, the profession's thrust is clearly forward.

Why update? Clearly our professional responsibility to our students and to society requires that they receive the best program possible -- one that is responsive to the technological demands of our world. A program that introduces students to modern technology and its processes.

Updating enables us to meet this responsibility. Additionally it brings its own rewards that often include:

- A boost in morale among students, parents, faculty and administration
- Increased relevance. This causes people to believe in the importance of our program's contribution to youth.
- Increased enrollments
- Better goal achievement and evaluations for you and the school.

But what does one update? Look around. That's right. The visible is a great place to start. If people see a significant change in the laboratory they are more likely to believe a programmatic change has also been made. Of course, facilities are but the vehicle through which we help youth learn about industry and technology, but they play an important role in securing support because they show tangible evidence of your commitment.

The program of studies must also be updated to reflect changes in technology. Program consists primarily of the following:

- Curriculum (content, activities and sequence)
- Facility (building, laboratory, equipment)
- School policies (course designation, advisement)

Teachers need to work to insure a consistency among these three main components of a program: curriculum, facility and policies. The recommended sequence is shown above. First one must clarify the purposes and form of the curriculum, its content, activities and sequences. Once the curriculum is established, one can analyze what is needed in terms of facility and equipment. Finally, a review of school policy needs to be conducted to insure that policies support the program? For example:

- Is ITE recommended for all students?
- Are ITE courses scheduled at times to permit all students to participate?
- Are ITE instructors provided reasonable time for preparation and summer/fall shut down/start up?
- Is the student association supported?

Development of the scope and sequence is another excellent way of updating the curriculum. This involves the establishment of course titles, descriptions and objectives and which provides a logical opportunity to update the program. At this time, it is also recommended to interact with math, science, English and vocational colleagues to identify appropriate ITE articulation mechanisms with general and vocational education courses.

What does updating involve? First, it requires a willingness to do things in a way different than before. Often it is difficult to see how this might be done. One of the best ways over this hurdle is to get outside opinions and perspectives. Start with good teachers and students in your own school, consider inviting the state supervisor, a teacher educator, or even a representative of industry. Be careful, however, that such advisors understand the overall purposes of ITE!

The key steps to the updating process are:

- Evaluate the program carefully. The Missouri Industrial Technology Standards (Provided in Chapter VIII's Part 3) are recommended to serve as a guide.
- Get outside opinion as to what might be improved and how to do it.
- Look at as many good examples of programming as you can.
- Carefully list the barriers for updating and how they might be overcome.
- Develop a plan identifying what needs to be updated and why.
- Tie your plan into major thrusts of the schools, e.g. VIMS, core competencies, reinforcement of basic skills or the like.
- Work out a proposal to systematically implement the desired changes, in priority order, over a reasonable period of time, e.g. five years.
- Market your plan to the key decision-makers in your district/building. Be sure to incorporate advantages for each of the key audiences.
- Get formal administrative approval for your plan.

5. Starting a New ITE Program

In some cases, a school system will be establishing a new ITE program. Typically, this occurs when:

- A new school is being built
- An existing program is being extended to a new setting, e.g.,
  - A junior high school program will be extended to the high school
  - A senior high school program will be extended to the junior high school
- A program, temporarily closed for the lack of a teacher, reopens when one is hired.

Generally, each of these situations presents a good time to rethink the overall program design. This involves:

1. Establishment of program goals (See Part 6 of this chapter).
2. Development of the program's scope and sequence (See Part 2 of this chapter).
3. Documentation of each course in the program (See Part 6 of this chapter).
4. Design/adaptation of the laboratory facility in which the program will be conducted (See Chapter III).
5. Review of school system policy (See Chapter VI).

These procedures have been described in other sections of this guide. Refer to these other pages for guidance on these steps. The overview of this process, and a time estimate for each step, is shown in Figure II-4.

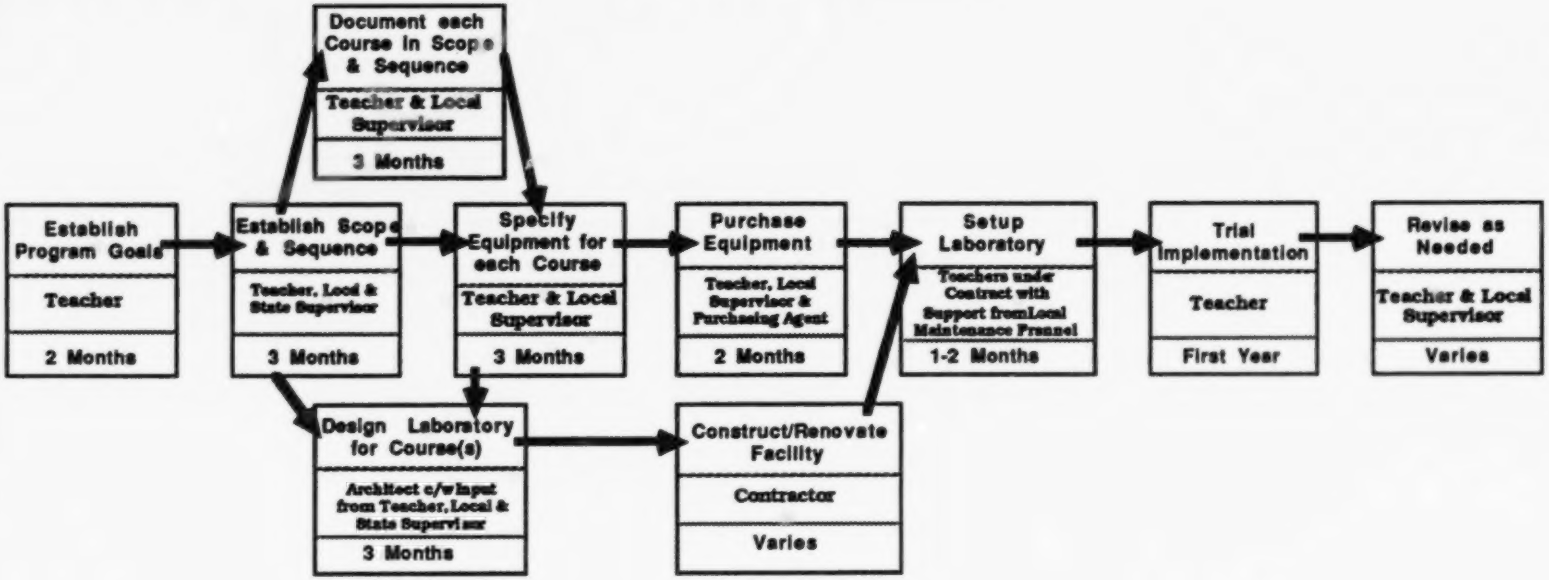

Establish Program Goals
Teacher
2 Months
Establish Scope & Sequence
Teacher, Local & State Supervisor
3 Months
Document each Course in Scope & Sequence
Teacher & Local Supervisor
3 Months
Specify Equipment for each Course
Teacher & Local Supervisor
3 Months
Design Laboratory for Course(s)
Architect c/w input from Teacher, Local & State Supervisor
3 Months
Purchase Equipment
Teacher, Local Supervisor & Purchasing Agent
2 Months
Construct/Renovate Facility
Contractor
Varies
Setup Laboratory
Teachers under Contract with Support fromLocal Maintenance Prsnnel
1-2 Months
Trial Implementation
Teacher
First Year
Revise as Needed
Teacher & Local Supervisor
Varies

Figure II-4 Steps in Implementing New Programs

6. Documenting the Curriculum

ITE teachers will often face a need to describe their curriculum on paper. This curriculum development results in documentation of the curriculum. Typically many different formats are used -- depending on the purposes each document is to serve -- i.e., who will be using it for what.

Curriculum Components

The following pages will highlight the essential features and quality guidelines for the various elements that document the curricula. Figure II-5 provides a flowchart showing one approach to curriculum documentation. The details of each curriculum component are provided as follows:

- Instructional Management System ....Page II-25
- Continuum of Objectives..Page II-28
- Course of Study...Page II-30
- Major Unit Plan...Page II-34
- Self-instructional Module...Page II-39
- Lesson Plans...Page II-50

Instructional Management Systems

In Missouri, there is serious commitment to instructional management systems (IMS) that encourage quality of programming. As a result, the Missouri Department of Elementary and Secondary Education has evolved a systematic IMS and the vocational community within Missouri's educational system has evolved a VIMS that can be a useful guide to curriculum development and quality control. Both systems are based on the same principles and these are combined into a generalized system which is pictured in Figure II-6.

IMS Step 1: The locally developed scope and sequence should state the course goals for each course in the ITE program sequence and they should be consistent with ITE's overall goals as provided in Chapter I

IMS Step 2: The second step is to establish a list of course competencies which are developed by each course in the ITE program. Chapter VIII's part 4 provides competency lists for the ITE program's five core courses.

IMS Step 3: Performance objectives are the third step in the process. Here instructors translate the competencies to be developed by each course into clear statements of educational outcomes. In ITE, these objectives usually involve performance in all three domains: cognitive (knowledge), affective (attitudes) and psychomotor (skills).

Typically, instructors will write performance objectives to detail specific lessons and/or activities. These objectives are written to include specific treatment of:

- Observable behavior/performance
- Conditions of instruction/testing
- Criteria for judging success

IMS Step 4: The IMS process' fourth step involves the development of instructional delivery methods and the materials needed to implement them. Although many different types exist, the most frequently used include:

- Courses of Study
- Major Unit Plans
- Lesson Plans
- Job Sheets/Assignment Sheets
- Information Sheets
- Self-Instructional Modules

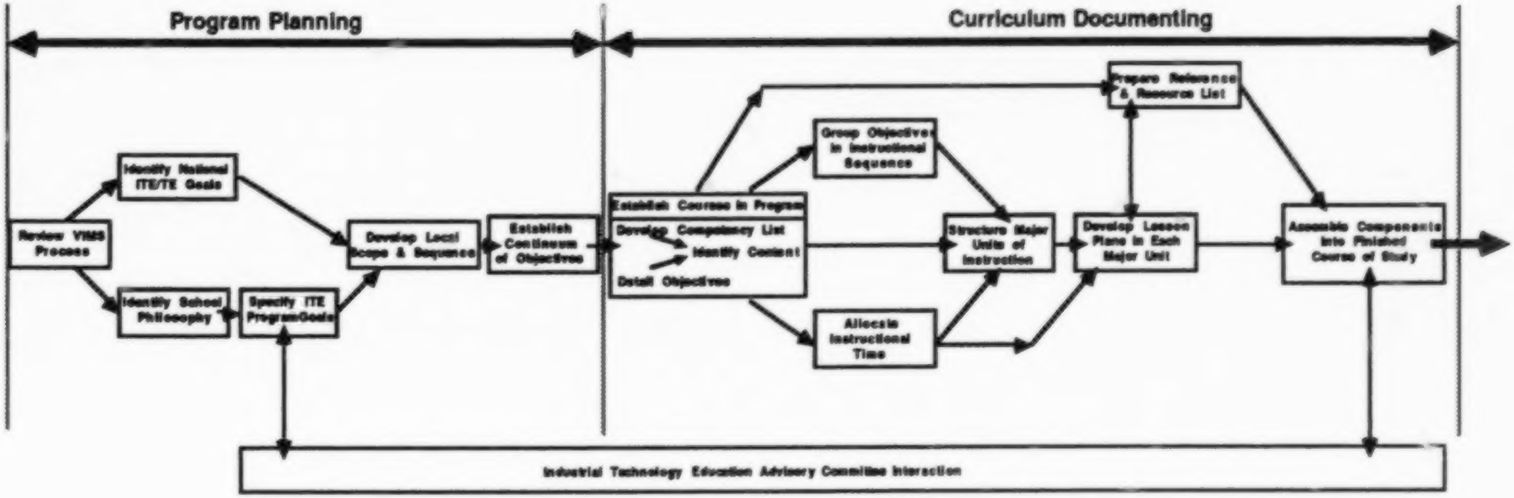
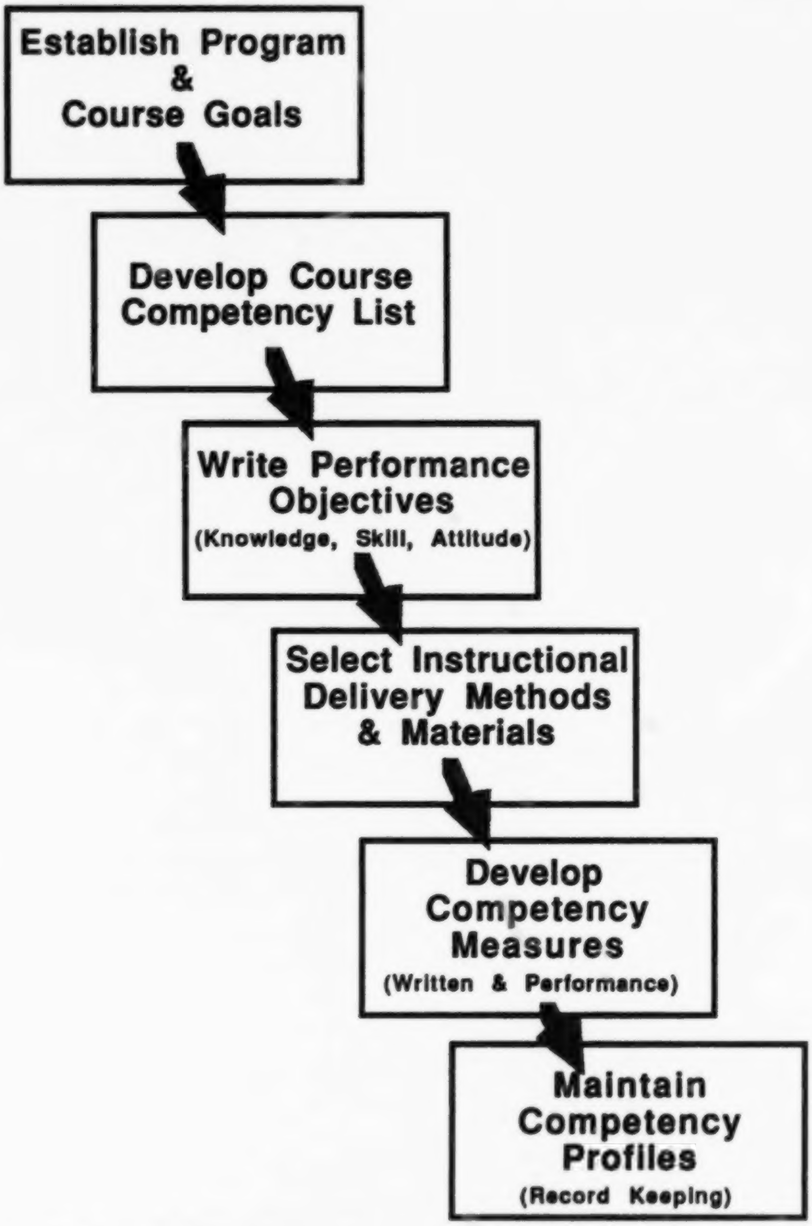

Program Planning
Curriculum Documenting
Review VIMS Process
Identify National ITE/TE Goals
Identify School Philosophy
Specify ITE Program Goals
Develop Local Scope & Sequence
Establish Continuum of Objectives
Establish Courses in Program
Develop Competency List
Identify Content
Detail Objectives
Group Objectives in Instructional Sequence
Allocate Instructional Time
Prepare Reference & Resource List
Structure Major Units of Instruction
Develop Lesson Plans in Each Major Unit
Assemble Components into Finished Course of Study
Industrial Technology Education Advisory Committee Interaction

Figure II-5 Steps in Documenting a Curriculum

Figure II-6

Component Parts of an Instructional Management System[1]


Establish Program & Course Goals
Develop Course Competency List
Write Performance Objectives
(Knowledge, Skill, Attitude)
Select Instructional Delivery Methods & Materials
Develop Competency Measures
(Written & Performance)
Maintain Competency Profiles
(Record Keeping)

---

[1] Adapted from Missouri's VIMS and consistent with Missouri's IMS.

IMS Step 5: The fifth step involves the development of competency measures for each lesson, major unit, or competency. Note that these can take many forms. Some useful ones are:

- Paper and pencil tests of all kinds
- Performance tests
- Observations and checklists
- Self-tests

IMS Step 6: Finally, IMS requires the careful recording of each students' progress towards mastery of the competency assigned to each course. This usually involves recording of "mastery," "mastery with supervision," or "not-attempted" beside each competency as the student demonstrates his/her capabilities.

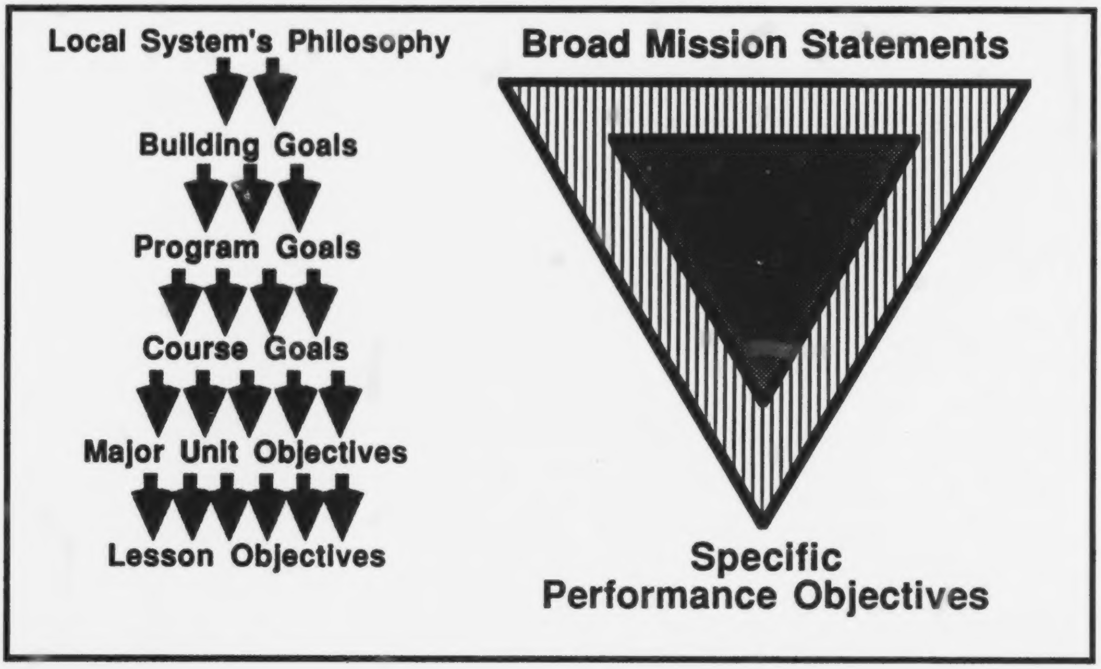
A locally developed IMS offers an excellent way to clarify and raise expectations for student achievement. The IMS concept is based on the conclusion that *all students* can meet reasonable academic and skill-performance standards on important educational objectives.

Continuum of Objectives

Quality Education has a continuity to it. This begins with a statement of the school system's philosophy of education. It is important that this statement provides an "anchor" for ITE. Usually this is by means of a statement that speaks to the importance of occupational (vocational), career, avocational and technological goals of schooling for the system. The local system's philosophy starts the entire chain (continuum) as shown in Figure II-7.

Figure II-7

The Continuum of Objectives


Local System's Philosophy
Building Goals
Program Goals
Course Goals
Major Unit Objectives
Lesson Objectives
Broad Mission Statements
Specific Performance Objectives

Now, with respect to any single course, it becomes obvious that any course accomplishes what its components, i.e., its major units of instruction accomplish. Therefore, it is absolutely imperative that the major unit goals within any course result in the achievement of all of the course's goals -- nothing less or more!

Using the same logic then, it becomes clear that each major unit's goals are accomplished through its lessons. Therefore, the cumulative effect of all the lessons in any major unit must be the achievement of all of the major unit's goals -- nothing less or more! When an instructor's system of program, course, unit and lesson documentation demonstrates such internal consistency, he/she may consider themselves to have reached a most important quality milestone.

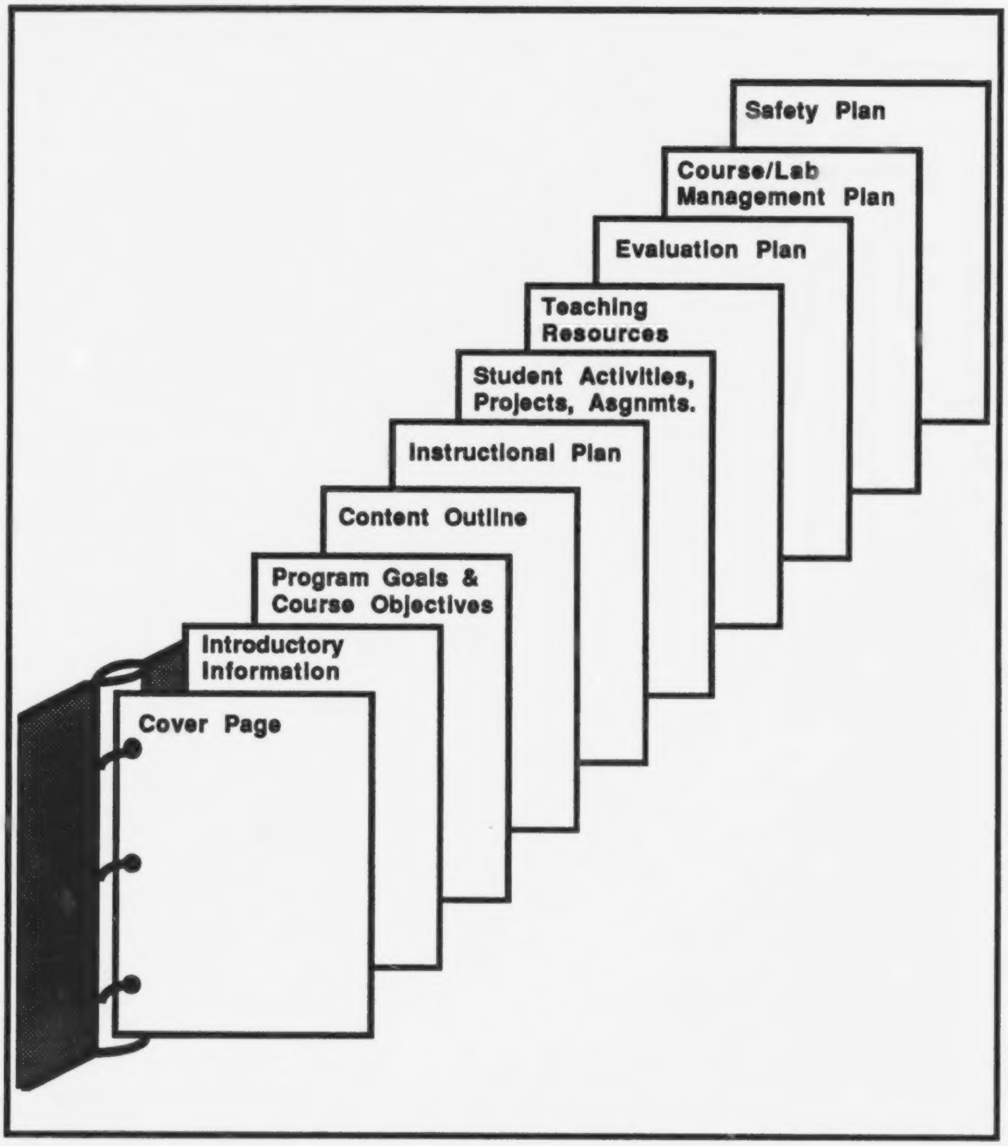
Course of Study

Perhaps the single most important product of course and program documentation is the course of study. Why? Because it is the package that assembles all of the components of curriculum documentation into one coherent whole. Ideally the course of study for each course should be neatly organized in a three-ring loose-leaf binder so that access, further development and revisions are facilitated.

Courses of study can contain many different items -- often because of local requirements. However, Figure II-8 shows a reasonable consensus of the most important categories of items and their logical sequence:

Figure II-8

Components of A Course of Study


Safety Plan
Course/Lab Management Plan
Evaluation Plan
Teaching Resources
Student Activities, Projects, Asgnmts.
Instructional Plan
Content Outline
Program Goals & Course Objectives
Introductory Information
Cover Page

The items included in courses of study, and the recommended information contained in each, are described in the following paragraphs. Of course each section may (and should) be tailored to meet local requirements -- however sections should not be diluted, i.e., contain less than what is recommended.

1. Cover Page
   a. A clear descriptive title and local system course number (if used) is provided. Also show the appropriate C&D report course number.
   b. Department, school, district, state and person preparing the course of study
   c. Date the course of study was prepared/revised

2. Introductory Information
   a. Foreword
      - Statements necessary to communicate intent of course
      - Acknowledgements (optional)

   b. Introduction & Overview
      - Nature, scope and organization of the course
      - Length of the course
      - Grade level and student for which the course is intended
      - Time allotment
      - Limits of the course
      - Credit to be earned
      - Prerequisites, if any

   c. Table of Contents

3. Program Goals and Course Objectives (In context)
   a. National Goals of ITE (optional)
   b. State Goals of Education and ITE
   c. Local System Philosophy
   d. School Philosophy of Education
   e. Local ITE Program Goals
   f. Course Objectives

4. Course Content Outline
   a. List of competencies to be developed by each student
   b. A narrative description of the content to be covered by the course

5. Instructional Plan
   a. Major Units of Instruction
   b. Time allotment for each major unit and each lesson plan within it.
   c. For each major unit, list
      - Title
      - Major Unit Objective(s) (Scope of Unit Statement)
      - Lesson Plan/Module Titles
      - Pre/Post Tests

6. Student Projects, Assignments and Activities (Major)
   a. Assignment sheet(s)
   b. Job sheet(s)
   c. Experiment sheet(s)
   d. Other related document(s)

7. Teaching Resources: Texts, Reference, Aids and Devices
   a. List major visual and auditory aids (films, cassettes, bulletins, etc.) to be used. Note, these can be listed in individual lesson plans, in separate lists for each major unit or in one overall list for each course
   b. List and use of models, charts, graphs, maps, etc.

8. Evaluation Plan
    a. Progress charts for recording student achievement (competency lists)
    b. Tables of specifications for each major test
    c. Unit tests
    d. Objective examination covering the entire course content and instructor's key
    e. Performance tests and checklists
    f. Self-administered progress checks for each major unit of instruction
    g. A plan for determining final grades

9. Course/Laboratory Management and Safety Plan
    a. Description of laboratory and/or classroom
    b. List of tools and equipment required (inventory)
    c. List of consumable materials and supplies
    d. Safety regulations and practices
    e. Laboratory and/or classroom regulations

The quality control of courses of study is most important because this is the key document that guides instruction. To assist instructors in developing course of study with the highest quality, it is recommended that each be checked against a checklist of desirable features. One such checksheet, compiled from North Central Association and other guidelines, is provided in Figure II-9. This checksheet is intended to be used by course developers and ITE program supervisors as a quality self-check.

Figure II-9

Course of Study: Quality Checksheet

Developer: ____________________ Course Title: ____________________

Course of Study Component	Not at all 1	2	3	4	Very Much so 5
1. Cover page provides essential information	___	___	___	___	___
2. Introductory Information is clearly provided in:					
• Nature and scope of course	___	___	___	___	___
• Grade placement and prerequisites	___	___	___	___	___
• Time allotment and credit	___	___	___	___	___
3. Program Goals and Course Objectives are stated clearly.					
• School or state	___	___	___	___	___
• Program	___	___	___	___	___
• Course	___	___	___	___	___
4. Content Outline is presented clearly.					
• Competency list	___	___	___	___	___
• Description of content	___	___	___	___	___
5. Instructional Plan provides a clear overview.					
• Major Units of Instruction are identified in sequence.	___	___	___	___	___
6. Student Projects, Assignments & Activities are identified.	___	___	___	___	___
7. Teaching Resources are listed.	___	___	___	___	___
8. Evaluation Plan contains:					
• Table of specifications for major evaluations	___	___	___	___	___
• Grading scheme	___	___	___	___	___
• Progress Chart	___	___	___	___	___
• Test format	___	___	___	___	___
9. Course/Laboratory Management & Safety Plan is clearly described.	___	___	___	___	___

Major Units of Instruction

It is recommended that each ITE course be organized into a group of major instructional units. These major instructional units are groups of lessons that have a common central theme. This theme helps pupils learn and master the competencies to be developed. Major instructional units should be long enough to cover the topics but short enough so that students never forget the unit's central unifying theme. Typically they range from one to four weeks in length. Older and/or more serious students can use longer units more effectively than less mature students.

Major units of instruction typically include four key components. These components and some of their key characteristics are:

1. Title & Number of Major Unit

   The title should highlight the central theme or unifying idea for the unit. Each major unit should be able to stand alone as a mini-course.

2. Unit Objectives (Scope of Unit Statement)

   Summarize the specific outcomes of all of the lessons which make up the unit. Include understandings, skills, appreciations, attitudes. Typically such statements do not need to be in performance terms because the lesson plans' objectives will be.

3. Instructional Analysis

   A list of information and demonstration lesson plan titles presented in the sequence they will be taught. Usually they are shown in a two-column format that highlights information and demonstration categories of lesson plans. Another important characteristic is that generally the information needed for any demonstration lesson is provided prior to giving the actual demonstration lesson. Describes the manner in which the unit may best be evaluated, e.g. observation, performance test, oral reports and so on.

4. Unit Evaluation

   Sometimes specific tests, which will be used to determine the extent the outcomes of the unit have been achieved, are listed. If a pre-test is used it should be listed also. The criteria which guide advanced placement and/or testing out of the unit. as well as for final success, should be prepared and documented.

Usually it is desirable to begin a major unit of instruction with an introductory lesson. This lesson sets the stage for all the others in the major unit. It presents the theme that ties all of the unit's lessons together and it is important that this first lesson motivates students.

Major units of instruction usually end with a review and summary lesson. Often a unit post-test is used to assure mastery of the desired competencies. If however, competency attainment has been recorded all along, then unit post tests are not necessarily needed although of course they still could serve a valuable review and synthesis function.

It is also essential that instructors insure that units are not boring. Major units should not all repeat the same pattern throughout the course. Similarly, the lessons' length/scope should be varied to maintain student interest and to fit the competencies to be developed.

Often it is also desirable to plan major units of instruction that include extra lessons or modules. Some of these should be targeted on gifted or accelerated students. Typically such lessons would involve new, advanced or more in depth topics.

Then, too, instructors will often find it valuable to identify the one or two of the most difficult competencies in each unit. It is recommended that some remedial or "Plan B" lessons/modules be developed to help learners who have not mastered the competencies to, after their initial try, go at it again.

Instructors will find it convenient to summarize each major unit of instruction on a one-page form. Figure II-10 shows one format that allows the instructor to record the important information about each major instructional unit. This format makes it easy to use in teaching as well as when communicating the instructional plan to interested parties.

To make it easier for instructors to make quality checks, such as the ratio of information to demonstration topics (time and number) another form, shown in Figure II-11 is useful. The major unit overview and analysis sheet shown in Figure II-11 encourages such analyses by providing space for each of the following:

1. Course and unit reference information
2. Each lesson title classified by information or demonstration type
3. The scheduled date for each lesson
4. Each lesson's time estimate and its actual time
5. Analysis of information/demonstration lesson ratio

The overview and analysis sheet also provides a system to record the instructor's estimate of teaching/laboratory time for each lesson and then another to record the actual time used. This will ease subsequent revision.

For a final, overall quality control check of their major units of instruction, ITE teachers are advised to use the checksheet provided in Figure II-12.

Figure II-10

Sample Major Unit of Instruction Format

Course: ____________________

Unit: ______ - ____________________
(number) (unit title)

Unit Objectives: ____________________
(scope of unit statement) ____________________

Instructional Analysis

Demonstration Topic	Informational Topic
	1. Pretest, Introduction & Overview
	2. Lesson title . . .
3. Lesson title . . .	
	4. Lesson title . . .
	5. Lesson title . . .
6. Lesson title . . .	
	7. Lesson title . . .
	8. Review & Summary Post-Test

Evaluation: Unit will be pre-tested and post-tested

Course Title/No.: ____________________

Unit: ______ (Number) ____________________ (Title)

Unit Objectives: ____________________
(Scope of unit statement) ____________________
____

Instructional Record

				Time Allotted/Used __ Hrs. __ Min. __ Periods			
Date Planned / Delivered	**Info. Topic #**	**Demo. Topic #**	**Lesson Title**	**Class**	**Lab.**	**Other**	**Total**
Number of Lessons	Demons'tn	Informa'tn	Total				
Percent of Lessons	%	%	Percent	%	%	%	%

Figure II-11 Major Unit Overview Sheet

Figure II-12

Major Unit of Instruction: Quality Checksheet

Developer: ______________________________

Course Title: ____________________ Unit Title ____________________

	Components	Not At all 1	2	3	4	Very Much so 5
1.	Unit title is appropriate and can stand as a mini-course	___	___	___	___	___
2.	Unit length is sized to suit students	___	___	___	___	___
3.	Overview/Introductory lesson is incorporated	___	___	___	___	___
4.	Summary/Review lesson plan is incorporated	___	___	___	___	___
5.	Demonstration lessons are preceded with information lessons for prerequisite information	___	___	___	___	___
6.	Overall sequence is not boring.	___	___	___	___	___
7.	Lessons are manageable in size and varied in nature.	___	___	___	___	___
8.	Provision is made for advanced and slower students.	___	___	___	___	___
9.	Lesson objectives derive from major unit objectives and do not exceed them.	___	___	___	___	___
10.	Each major unit objective is attended by one or more lesson objectives.	___	___	___	___	___
11.	Provision is made for reinforcement of learning.	___	___	___	___	___
12.	Unit pre- and/or post-tests are provided for.	___	___	___	___	___
13.	The competencies prerequisite for unit success are identified and assessed at start of unit.	___	___	___	___	___
14.	Provision is made for students to check their own progress throughout the unit.	___	___	___	___	___

Self-Instructional Modules

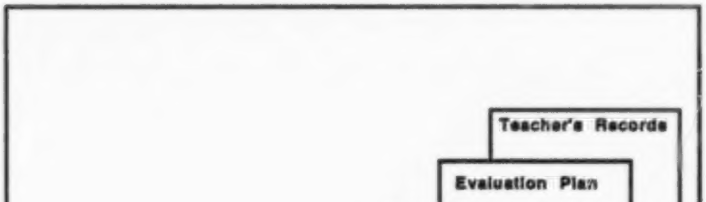
Teachers of all subjects, and particularly industrial technology instructors, often report effective results when using self-instructional modules to develop key competencies. Typical examples of useful modules include reading a ruler, converting fractions, machine components, recognition, safety, career information and the like. Such modules can be used to:

- deliver mainstream instruction
- enrich a course (provide experiences to fast-track students)
- provide remediation to make up for weak work or lacking performance
- develop prerequisite competencies necessary for success in the course
- individualize instruction in a course
- provide for special needs students

Generally, most modules of instruction contain much the same information, although it may be arranged in different layouts. Also, the media used may differ according to local needs or availability. For example, one school program may employ paper (printed) modules while another uses slides and tapes. Yet another may use a combination of available media. Figure II-13 provides an overview of the components used to document self-instructional modules. Following this are some guidelines for developing each component in the module. A sample of the forms for using this format is then provided in Figure II-14.

Figure II-13

Self-Instructional Module Components


Teacher's Records
Evaluation Plan
Post-Test
Student Activities, Projects, Asgnmts.
Instructional Content
Pre-Test
Module Instructions
Title & Objectives
Module Cover

Module Cover Page.

1. Course:
2. Major Unit of Instruction:
   In which the module is to be used
3. Module Title & Number:
   Description of the module's content
4. Developed by:
   Module Author
5. Date:
   When this module was developed and/or revised

Module Page 2. Title & Objectives.

1. Module Title:
2. Objectives/Competencies:
   Detailed performance objectives for this module stated in a manner that students understand. Specifies observable performance, conditions of learning and/or testing and success criteria.

Module Page 3. Directions.

1. Directions for this module:
2. Special safety considerations:
3. Needed items:
   - Equipment
   - Supplies
   - Handout
   - Instructional Resources
4. Definitions/Glossary:
   Of any special or new terms used in this module.

Module Page 3. Pre-test.

1. Pretest:
   Diagnostic test used to assess whether students have necessary prerequisites for success in this module or whether they have already mastered it. Such pretests may be written or performance and for selected non-safety areas they may be self-scored by the students.
2. Keys for Student:
   For student scoring if appropriate

Module Page 4 a, b, c ... as needed. Instructional Content.

1. Introduction/Set:
   This section must establish, in the student's own language, the module's context. It must build student motivation and clearly demonstrate the module's relevance to the students. This section must create the perception of usefulness to the student because the instructor will not be there to do so.

2. Learning Activities/Steps of Procedure:
   This section presents the content essential to the module. Also it provides students with a clear list of the steps of procedure that need to be followed.

3. Information sheets:
   These are often used to provide summary information or to supplement assigned readings or media.

4. Self-checks:
   These allow students to check their own progress. These are particularly useful in longer modules.

5. Work/Activity Sheets:
   These are used to structure student responses.

6. Review & Summary:
   Because modules are self-instructional in nature, it is very important that they include a section to bring closure to the learning experience since the instructor will typically not be present to do this.

7. Next Steps:
   This section tells the student what to do after completing the learning activities in the module.

Module Page 5. Assignments.

1. Assignments:
   Occasionally modules are used to guide students to do an assignment outside the module's internal learning activities. In these cases assignment sheets are used.

2. Checksheets:
   Used to give students an idea about how the assignment will be scored.

Module Page 6. Post-test.

1. Post Test:
   This test is used to effectively measure student achievement (mastery) of the module's objectives. Such tests may be written, performance, or observational in nature. They need to be indexed to the course/unit/ module competencies that are to be developed. Ideally, the post-test results will tell the instructor which competencies to mark as "mastered."

2. Keys for Student:
   For student scoring if appropriate

Module Page 8. Teacher Records.

1. Teacher Records:
   This section is found only in the teacher's master copy of each module. Here he/she records anecdotal notes and/or student feedback that will be used to revise the module.

2. Instructor Records:
   Also, it would be wise for the instructor to list the references he/she used to develop this module.

3. Keys:
   Pre- and post-test keys should also be filed in this section of the module.

Figure II-14

Sample Self-Instructional Module Format

(Module Cover Page)

Course:

Major Unit of Instruction:

Module Title & Number

Developed by:

Date:

Figure II-14, Continued

(Module Page 2)

Module Title:

Objectives/Competencies:

Figure II-14, Continued

(Module Page 3)

Directions for this Module:

Special Safety Considerations:

Needed Items:

1. **Equipment**

2. **Supplies**

3. **Handouts**

4. **Instructional Resources**

Definitions/Glossary:

Figure II-14, Continued

(Module Page 3)

Pre-Test

Instructions:

Test:

Figure II-14, Continued

(Module Page 4 a, b, c ... as needed)

Introduction/Set:

Review & Summary (attach following this page as needed):

Learning Activities & Steps of Procedure:

Next Steps (attached following this page as needed):

- **Work/Activity Sheets** (attach following this page as needed):
- **Information sheets** (attach following this page as needed):
- **Self-checks** (attach following this page as needed):

Figure II-14, Continued

(Module Page 5)

Assignments:

Figure II-14, Continued

(Module Page 6)

Post-Test

Instructions:

Test:

Figure II-14, Continued

(Module Page 7)

Teacher Records

Teacher Notes:

Student Feedback:

Revision Ideas:

Lesson Plans

Most teachers will use some form of lesson plan to guide their daily instructions and to document their plans for legal, professional and other grounds. Lesson plans help teachers prepare for a lesson; they save time (after initial development); they provide a base for subsequent revisions; they facilitate instruction when teachers are ill and substitutes are used; they can be used to document performance; and they provide a convenient means to individualize instruction.

It is recommended that instructors use two versions of lesson plans to document their day-to-day instruction:

- Information lesson plans provide the essential information (usually technical, guidance, or general) needed for mastery of the course competencies.
- Demonstration lesson plans guide student development of the essential sensori-motor competencies in the course.

The following pages provide explanations and instructions for developing lesson plans. Lesson plan formats can be very detailed as shown in Figure II-15 or a simplified format such as shown in Figure II-16 may be preferred. Often local school systems use their own special lesson plan format but usually the same components are involved as are used in the forms detailed here. Samples (Figures II-17 and II-18) of both information and demonstration lesson plans are provided right after these explanations.

Figure II-15

Sample Lesson Plan Format (Detailed)

Lesson Title: ______________________________ Lesson Plan #________ Page# ________
Information: ______ Demonstration: _____

COURSE TITLE/NO.: ____

UNIT: ________ -- ____
(Number) (Unit Title)

UNIT OBJECTIVE(S): ____
(SCOPE OF UNIT):
____

LESSON OBJECTIVE(S):

THE STUDENT WILL BE ABLE TO:

REQUIRED RESOURCES: (Instructional Aids, Tools, Equipment, Supplies, Handouts, Etc..)

Developed By: ______________________________ Date: _______ Revised: _______

Special Learning Features For: ____________________________________

Figure II-15, Continued

Lesson Title:____________________________________ **Lesson Plan #** _____ **Page #** _____

INFORMATIONAL ASSIGNMENT: (Student References)

REFERENCES: (Instructor References)

INTRODUCTION: (Create perceived purpose, set induction, prepare students for the lesson)

Figure II-15, Continued

Lesson Title: ________________________________ Lesson Plan #____ Page# ____

COURSE TITLE/NO.: ________________________________

UNIT: ________ -- ________________________________
(Number) (Unit Title)

UNIT OBJECTIVE(S): ________________________________
(SCOPE OF UNIT):
____

CONTENT OUTLINE:

Figure II-15, Continued

Lesson Title: ______________________________ Lesson Plan #____ Page# ____

COURSE TITLE/NO.: ______________________________

UNIT: ________ -- ______________________________
(Number) (Unit Title)

UNIT OBJECTIVE(S): ______________________________
(SCOPE OF UNIT): ______________________________

STEPS OF PROCEDURE:

Figure II-15, Continued

Lesson Title: ______________________________ Lesson Plan #____ Page# ____

COURSE TITLE/NO.: ______________________________

UNIT: ________ -- ______________________________
(Number) (Unit Title)

UNIT OBJECTIVE(S): ______________________________
(SCOPE OF UNIT):
____

INTERACTION ITEMS: (To be keyed for use during presentation)

CLASSROOM, LABORATORY, OR OTHER ACTIVITIES:

82

Figure II-15, Continued

Lesson Title: ______________________ Lesson Plan #____ Page# ____

COURSE TITLE/NO.: ______________________

UNIT: ________ -- ______________________
(Number) (Unit Title)

UNIT OBJECTIVE(S): ______________________
(SCOPE OF UNIT): ______________________

EVALUATION ITEMS: (Oral/written/performance items measuring attainment of lesson objectives)

Figure II-15, Continued

Lesson Title: ______________________________ Lesson Plan #____ Page# ____

COURSE TITLE/NO.: ______________________________

UNIT: ________ -- ______________________________
(Number) (Unit Title)

UNIT OBJECTIVE(S): ______________________________
(SCOPE OF UNIT): ______________________________

REVISION NOTES: (This page is used to record instructor and student feedback for subsequent lesson plan revisions. Tests keys are also recorded on this page.)

1. Student feedback

2. Revisions to be made

3. Test/Assignment keys

Figure II-16

Sample Lesson Plan Format (Simplified)

Course: ____________________ **Unit #:** __________

Unit: ____________________ **Lesson Plan #:** __________

Lesson Topic: ____________________

Objective(s): ____________________

____

Resources: (Tools, equipment, supplies) ____________________

____

Instructional Approach: ____________________

____

____

Content Outline (or **Steps of Procedure**):

- **Introduction:** ____________________

  ____

- **Content:** ____________________

  ____

  ____

- **Summary:** ____________________

  ____

Learning Activities: ____________________

____

____

Evaluation: ____________________

____

Interaction Items: ____________________

____

Because lesson plans are typically the single most important determinant of quality in day-to-day instruction it is crucial that they are developed properly. The following guidelines and instructions[1] will help industrial technology teachers maximize the quality of their lesson plans:

Instructions: Lesson Plan Page 1 (White).

DOCUMENTATION BLOCK	
• Lesson Title	This should describe the lesson's content and should be stated to raise student interest in the topic.
• Lesson Plan #, Page #	Consecutively number the lesson plans in each major unit of instruction. Also number the pages within each lesson.
• Information or Demonstration	Check to indicate the type of lesson. Information lessons provide needed cognitive and affective information. Demonstration lessons develop a manipulative skill in a step-by-step manner.
• Course Title/No.	List as your courses appear in your school/institution catalog.
• Unit #, Title	Documents which unit (title & #) of your course this lesson belongs to.
• Unit Objectives (Scope of Unit Statement)	This statement lists objectives the teacher desires to achieve in the unit. It is a summary of the theme that ties all of the lessons together to provide continuity. This remains the same for each lesson plan within a unit.
LESSON OBJECTIVE(S)	Describes the performance(s) expected of the students upon successful completion of the lesson. It/they should be listed in performance terms with clear behavior, conditions and criteria for success.
REQUIRED RESOURCES (Instructional aids, tools)	List all items needed to teach the lesson. This becomes a checklist to insure readiness.
DEVELOPED BY	Indicates the author of the lesson plan.
DATE WRITTEN/REVISED	Indicates the date the lesson plan was written or revised.
SPECIAL LEARNING FEATURES	Lists the special learning features that this lesson has built into its delivery system, i.e. group/individual instruction, hearing difficulties, reading difficulties

Instructions: Lesson Plan Page 2 (White).

INFORMATIONAL ASSIGNMENT (Student references, text, reference books, information sheets, etc.)	List the exact book, author and page numbers of the material you wish the student to read. List all other materials on a similar basis.
REFERENCES (Instructor references)	List all of the references and page numbers you used in the preparation of the lesson. When you need to review or revise a lesson, you can get to this exact reference and pages quickly.

---

[1] Adapted from King, 1975.

INTRODUCTION	Prepare the student to listen to and participate in the lesson. Tell the importance of, the reasons for, and the use of, the instruction which will follow. Create perceived purpose.

Instructions: Information Lesson Plan Page 3 (Yellow).

DOCUMENTATION BLOCK (Lesson Plan #, Page, Title, Major Unit Name)	Complete the spaces provided at the top of each page for easy filing and retrieval of your lesson plans and to avoid mixup of lesson plan pages.
CONTENT OUTLINE (Yellow)	Used for information-type lessons. Information is best organized in outline form. The style may be topical in format, e.g.: I. Definition of Terms A. Apprenticeship B. Building Trades Alternatively, it may be in sentence format, e.g.: I. For understanding the material, it is essential to be able to define the terms of the occupation. A. Apprenticeship is a term used ... B. Building trades refers to ... Remember: Teach from the outline - don't read it to sleeping students. Be certain to include a review and summary. Use as many pages of content outline as you need and number them consecutively.

Instructions: Demonstration Lesson Plan Page 3 (Green).

DOCUMENTATION BLOCK	Complete the spaces provided at the top of each page for easy filing and retrieval of your lesson plans and to avoid mixup of lesson plan pages.
STEPS OF PROCEDURE (Green)	To be used when preparing and demonstrating a manipulative-type skill. List the steps of your demonstration in the order performed. Example: Step #1 - ... Step #2 - ... to Final Step - ...

Instructions: Lesson Plan Page 4 (Blue).

DOCUMENTATION BLOCK	Complete the spaces provided at the top of each page for easy filing and retrieval of your lesson plans and to avoid mixup of lesson plan pages.

INTERACTION ITEMS	Keep up student interest by listing and asking questions about key points. Answer your own question if you like! These items are great for class discussion, too. Provide yourself a clue as to when to ask interaction items by penciling a note on your lesson outline. Note! By preparing questions in advance, you will ask better questions.
CLASSROOM, LABORATORY, OR OTHER ACTIVITIES	Design assignment activities to supplement your instruction. Give each student a chance to apply the lesson content. Examples of activities are: demonstrations, reports, group discussion, role-playing, field trips, etc. Plan, list, and assign activities - watch students learn! If you prefer to use separate sheets for such assignments just list them here and insert these sheets following this lesson plan page.

Instructions: Lesson Plan Page 5 (Pink).

DOCUMENTATION BLOCK	Complete the spaces provided at the top of each page for easy filing and retrieval of your lesson plans, and to avoid mixup of lesson plan pages.
EVALUATION ITEMS (Oral, written or performance to measure attainment of lesson objectives)	You must evaluate student accomplishment of the lesson objectives. An ideal time to plan your evaluation is when you first finish writing your lesson content. You should list items to measure your desired outcomes before instruction begins. Your objectives tell what you expect the students to be able to do, your content tells what is important, interaction items help emphasize key points of the lesson and your activities reinforce instructions and learning. Write test items to measure the specified objectives in the form and type best suited to each objective - oral, written or performance. At test time, select items from those you have written. It is a great feeling to prepare a test over the exact materials covered.

The preceding instructions serve as a guide to developing quality lesson plans in a very detailed form. Often even good ITE instructors find their time at such a premium that it will not permit such a high level of detail. Despite this, instructors are encouraged to start out using this format, but perhaps only developing the objectives, set and content outline sections at first. Then in subsequent years, or when time permits, one can gradually add to the documentation and develop a complete package. Figures II-17 and II-18 provide one-page examples of short format lesson plans that might be appropriate for a beginning.

While developing a set of lesson plans using the preceding instructions, ITE teachers are advised to check the quality of what they have developed. The Lesson Plan Quality Checksheet, shown in Figure II-19, provides a convenient way to insure lesson quality. It is recommended that from time-to-time, instructors take the time to use the checksheet on a sample of the lesson plans. Using the forms provided in Figures II-15 and II-16 also helps us by providing a standardized format.

Figure II-17

Sample Information Lesson Plan Format[1]

COURSE: Introduction to Technology Unit #: 7

UNIT: Employability Skills Lesson Plan #:

LESSON TOPIC: Ways of Getting a Job: The Resumé

OBJECTIVE(S):	Given four sample resumés, the student will develop his/her own resumé containing complete information in each of the necessary categories as indicated by the samples.
RESOURCES: (Tools, Equipment, supplies)	Copies of four teacher-prepared sample resumés for each student.
INSTRUCTIONAL APPROACH:	Presentation/Discovery Supervised Individual Activity
CONTENT: • Introduction	This past week we have been talking about various ways of getting a job. Today, I want you to assume that you will be completing school soon and consequently you have been watching the "help wanted" column in the local newspaper. This morning you noticed a job opening that appeals to you, but the ad suggests that you send a resumé to box 47 in care of that paper.
• Content	Resumés communicate....; Proofread your resumé...
• Summary	You have covered ...
LEARNING ACTIVITIES:	Students will study the four samples individually to discover for themselves the types of information contained in a resumé and the format required.
(20 minutes)	Based on what they have discovered, each student will prepare his/her own resumé.
EVALUATION: (15 minutes)	Students will pair off, trade papers and discuss each resume, evaluating the completeness of each On the basis of the four samples. Each student will then make a final draft of his/her resumé incorporating any necessary revisions. Final evaluation will be made by the teacher using the four samples as guidelines.
INTERACTION ITEMS:	#1 What was the objective of this lesson?
(15 minutes)	#2 What information should a resumé contain?
	#3 Why should attention be given to the preparation of the resumé?

---

[1] Adapted from Develop A Lesson Plan. Module B-4. Performance Based Teacher Education Module Series. Columbus, Ohio: The National Center for Research in Vocational Education, Second Edition.

Figure II-18

Sample Demonstration Lesson Plan Format[1]

COURSE: Any Course Unit #: 2

UNIT: Basic Machine Operation Lesson Plan #:

LESSON TOPIC: Operating a . . .

OBJECTIVES:	These list what is to be achieved as a result of the lesson. They should be brief and concise.
RESOURCES: (Tools, Equipment and Supplies)	Lists tools, equipment and supplies necessary to teach the lesson.
INSTRUCTIONAL APPROACH:	Demonstration followed by student "walk throughs."
INTRODUCTION:	States specifically how student attention is to be obtained and how interest is to be developed. This step may be any length but is usually three to five minutes duration. This step should lead smoothly into the presentation of procedures step.
STEPS OF PROCEDURE:	Lists each step and key point necessary to perform the operation or operations. Length of presentation typically ranges 30 to 45 minutes. State steps clearly and concisely in occupational/technological terms. List steps in proper sequence. Number each step consecutively. Key points should be listed with steps where they apply.
SUMMARY:	This draws together the lesson's key points and it prepares students for their assignments!
LEARNING ACTIVITIES:	Student is assigned an activity (e.g. experiment, project, problem, etc.) from the course of study, involving the operation or operations presented. Supply student with the appropriate information handouts or have student review the assigned readings/media. Effectively motivate students when making job assignment. The job assignment should be such that it can be completed within an appropriate time. The instructor supervises the work but should not work on the student's job Provision for individual differences should be made.
EVALUATION:	Check quality, time and techniques. Criteria for checking are to be based on acceptable standards. A checklist is recommended to insure reliability.
INTERACTION ITEMS:	These are keyed to the steps of procedure in order to prompt student thinking.

---

[1] Adapted from Develop A Lesson Plan. Module B-4. Performance Based Teacher Education Module Series. Columbus, Ohio: The National Center for Research in Vocational Education, Second Edition.

Figure II-19

Lesson Plan: Quality Checksheet

Developer:__________________ Lesson Plan Title: __________________ Unit Title: ______________

Component	Not at all 1	2	3	4	Very Much So 5
1. Major Unit Title is entered correctly.	___	___	___	___	___
2. Scope of Unit statement provides an overview of all lessons in the major unit and it is keyed to one or more course objectives.	___	___	___	___	___
3. Information Lesson or Demonstration Lesson blank has been numbered to indicate its order in the major unit.	___	___	___	___	___
4. Lesson Title is concise, descriptive, challenging to the student and is identified in the instructional analysis.	___	___	___	___	___
5. Lesson Objective(s) identify the performance, conditions and criterion level expected.	___	___	___	___	___
6. Required Resources, Teaching/Learning items have been identified.	___	___	___	___	___
7. Information Assignments and References have been listed with page numbers.	___	___	___	___	___
8. Introduction creates interest, explains what, why, when, where, and how this lesson is being presented.	___	___	___	___	___
9. A. Information Lessons present the content in outline form	___	___	___	___	___
or					
B. Demonstration Lessons present the steps of procedure in the skill and these are listed in prerequisite order.	___	___	___	___	___
10. Interaction Items have been listed as questions and keyed to the lesson.	___	___	___	___	___
11. Classroom, Laboratory, or Other Activities have been identified for immediate application of the lesson content.	___	___	___	___	___
12. Evaluation Items are developed to measure student attainment of each lesson objective/and keys are provided on the teacher's lesson plan page.	___	___	___	___	___

Performance Objectives

Throughout the curriculum documentation process, instructors will need to develop performance objectives. Usually these will be used in lesson plans and self instructional modules. Such objectives must clearly indicate:

- The desired performance to be learned and demonstrated.
- The conditions under which the performance is to be learned or tested.
- The criterion or standard which will be used to judge the success of the performance, i.e., to decide whether the student demonstrated mastery of the desired competency.

It is highly recommended that instructors analyze the mix of cognitive, affective, and psychomotor objectives they have in each of their major units of instruction. To do this, after each major unit's lessons have been developed, i.e., objectives have been specified, instructors often classify them by domain and level. The goal is to avoid an imbalance of objectives in any one domain or a predominance of objectives at low levels of any domain. The following summary of key domain and level characteristics is provided to help in analyzing instructional objectives.

Educational objectives have been classified into three domains: cognitive, affective and psychomotor. The cognitive domain includes those educational objectives related to the recall of knowledge and the development of intellectual abilities. The affective domain involves values, attitudes and changes in a pupil's emotional state. The psychomotor domain includes objectives that involve primarily muscular or motor skills, some manipulation of material and objects, or some act that requires a neuromuscular coordination (adopted from Krathwohl and others, 1964, p. 7) The taxonomies, i.e. classification systems, are each organized into a hierarchy of specialized capabilities within each domain as shown in Figure II-20.

The checksheet in Figure II-21 provides a way for instructors to monitor and maximize the quality of their objectives. The checksheet's scales are self-explanatory and should be applied to a sampling of objectives listed in each course's major units, lesson plans and/or modules.

Figure II-20

Cognitive, Affective and Psychomotor Domains[1] of Educational Outcomes

Cognitive Domain. The taxonomy for the cognitive domain contains six subdivisions and these in turn are further divided into more specific divisions. The six main subdivisions are as follows

1.00 KNOWLEDGE
The recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting.

2.00 COMPREHENSION
A type of understanding or comprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

3.00 APPLICATION
The use of abstractions in particular and concrete situations. The abstractions may be in the form of general ideas, rules of procedures, or generalized methods.

4.00 ANALYSIS
The breakdown of a communication into its constituent elements or parts such that the relative hierarchy of ideas is made clear and/or the relations between the ideas expressed are made explicit. Such analyses are intended to clarify the communications, to indicate how the communication is organized and the way in which it manages to convey its effects, as well as its basis and arrangement.

5.00 SYNTHESIS
The putting together of elements and parts as to form a whole. This involves the process of working with pieces, parts, elements, etc. and arranging them in such a way as to constitute a pattern or structure not clearly there before.

6.00 EVALUATION
Judgments about the value of material and methods for given purposes. Quantitative and qualitative judgments about the extent to which material and methods satisfy criteria.

Affective Domain. In this taxonomy, which classifies levels of attitudes, values and preferences, five main subdivisions have been identified (Krathwohl and others, 1964, pp. 176-185).

1.00 RECEIVING (ATTENDING)
The sensitization of the learner to the existence of certain phenomena and stimuli. He/she is willing to receive or to attend to them. This is the first and crucial step if the learner is to be properly oriented to learn what the teacher intends.

2.00 RESPONDING
Pupil responses that go beyond merely attending to the phenomenon. The pupil is sufficiently motivated that he/she is not just willing to attend but to attend actively. This is the category that many teachers find best describes their "interest" objectives.

3.00 VALUING
Recognition that a thing, phenomenon, or behavior has worth. This abstract concept of worth is in part a result of the individual's own valuing or assessment, but it is much more a social product that has been slowly internalized or accepted and has come to be used by the pupil as his/her own criterion of worth. This category is appropriate for many objectives using the term "attitude" and, of course, "value."

---

[1] From Bloom, 1956; Krathwohl, 1964; Simpson, 1966.

Figure II-20, Continued

Cognitive, Affective and Psychomotor Domains of Educational Outcomes

4.00 ORGANIZATION
The beginnings of the building of a value system. As the learner successively internalized values, he/ she encounters situations for which more than one value is relevant. Thus the necessity arises for (a) the organization of the values into a system, (b) the determination of the interrelationships among them, and (c) the establishment of the dominant and pervasive ones.

5.00 CHARACTERIZATION BY A VALUE OR VALUE COMPLEX
Integration of beliefs, ideas, and attitudes into a total philosophy or world view. The values already have a place in the individual's value hierarchy, are organized into some kind of internally consistent system, have controlled the behavior of the individual for a sufficient time that he/she has adapted to behaving this way, and an evocation of the behavior no longer arouses emotion or affect except when the individual is threatened or challenged.

Psychomotor Domain. Clearly there exists no single preferred classification for sensori-motor behavior. However, one approach, based on the degree of complexity in psychomotor behavior, was developed by Simpson (1966). Attention is on the sequence involved in learning motor acts (skills). Seven major steps are involved in her taxonomy:

1.00 PERCEPTION
The process of becoming aware of objects, qualities, or relations by way of the sense organs. It is a necessary, but not sufficient, condition for motor activity and it is basic in the situation --> interpretation --> action chain leading to motor activity.

2.00 SET
Preparatory adjustment or readiness for a particular kind of action or experience (mental, physical, or emotional)

3.00 GUIDED RESPONSE
An early step in the development of skill. Emphasis is on the abilities that are components of the more complex skill. Guided response is the overt behavioral act of an individual under the guidance of the instructor or in response to self-evaluation where the pupil has a model or criterion against which he/she can judge his performance

4.00 MECHANISM
Achievement of a certain confidence and degree of proficiency in the performance of the act. The act is a part of the learner's repertoire of possible responses to stimuli and the demands of situations where the response is an appropriate one.

5.00 COMPLEX OVERT RESPONSE
Attainment of skill. The individual can perform a motor act that is considered complex because of the movement pattern required. The act can be carried out smoothly and efficiently.

6.00 ADAPTATION
Altering motor activities to meet the demands of new problematic situations requiring a physical response.

7.00 ORIGINATION
Creating new motor acts or ways of manipulating materials out of understandings, abilities, and skills developed in the psychomotor areas.

Figure II-21

Performance Objective: Quality Checksheet

Developer:________________ Lesson Plan Title: ________________ Unit Title:________________

Component	Not at all 1	2	3	4	Very Much So 5
1. Performance - Does the objective describe what the learner will be doing to demonstrate that he/she has attained the objective? The objective specifies what the learner is to do and not what the teacher is going to do?	___	___	___	___	___
2. Condition - Does the objective specify the important conditions under which the learner must demonstrate his/her competence?	___	___	___	___	___
3. Criterion - Does the objective describe the criteria by which the learner's performance proficiency can be judged?	___	___	___	___	___
4. Preciseness and Clarity - Has the objective been specified using action words that preclude misinterpretation?	___	___	___	___	___
5. Success Expectation - Has the objective been stated with sufficient detail to assure that the expected performance outcome can be recognized?	___	___	___	___	___
6. Completeness, relevance and achievability - Is each objective completely stated, relevant to the course and achievable in the student's eyes?	___	___	___	___	___

7. Resources

________. Develop a Lesson Plan. Module B-4, Performance Based Teacher Education Series. Columbus, OH: National Center for Research in Vocational Education, Second Edition.

________. Drafting and Design. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, n.d.

________. Electricity/Electronics. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, n.d.

________. Energy and Power Curriculum Guide for Industrial Arts Education. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, n.d.

________. Guidelines for Occupationally Oriented Industrial Arts Education Programs. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, Division of Career and Adult Education, n.d.

________. Handbook for Industrial Arts Education. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, 1977, [IA-2-1].

________. Handbook for Vocational Education. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, Division of Career and Adult Education, 1981.

________. Industrial Arts Education in Transition: The Emergence of Technology Education. New Jersey: Commission on Industrial Arts Education, 1985.

________. Industrial Technology Systems Handbook for Industrial Arts/Technology Education. Columbus, OH: The Ohio State University/Ohio Industrial Arts Association, 1985.

________. Instructions for Completing Forms C & D of the Application for Classification. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, 1985.

________. Introduction to Vocational Education Instructional Management. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, May 1984.

________. Iowa Industrial Arts Handbook for Selected Aspects of Organization and Administration. Des Moines, IA: Iowa Department of Public Instruction, n.d.

________. Master Plan for Industrial Arts in the State of New Mexico. NM: University of New Mexico, n.d.

________. Metals. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, n.d.

________. Plastic Technology. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, n.d.

________. Quality Features for Industrial Education Programs: A Guide Designed to Enhance and Support the Illinois Plan. No. 278a. Macomb, IL: Illinois State Board of Education, n.d.

________. Relationship of the Industrial Arts/Technology Curriculum to Vocational Education in Ohio. OH: Ohio Council on Vocational Education, 1985.

________. Resource Directory of Curriculum Centers/Labs. Stillwater, OK: Vocational Instructional Materials Section (AVA) and National Network for Curriculum Coordination in Vocational Technical Education, Revised, June 1985.

________. Standards and Evaluation Criteria for Industrial Arts Programs (Public and Private 7-12). Jefferson City, MO: Missouri Department of Elementary and Secondary Education, 1978.

________. Technology Education: A Perspective on Implementation. Reston, VA: American Industrial Arts Association, 1985.

________. The Illinois Plan for Industrial Education: A Planning Guide. Springfield, IL: Illinois State Board of Education, 1983.

________. The Iowa Guide for Curriculum Improvement in Industrial Arts, K-12. Des Moines, IA: Department of Public Instruction, 1980.

Bloom, Benjamin S. (Ed.). Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook 1, Cognitive Domain. New York: David McKay, 1956.

Darrow, Don & Pine, Douglas. Iowa Industrial Arts Handbook. Des Moines, IA: Iowa Department of Public Instruction, 1980.

Dyrenfurth, Michael. J. et al. To Build A Future . . . . Missouri Industrial Arts Study Project Report. Columbia, MO: University of Missouri-Columbia, Department of Practical Arts and Vocational-Technical Education, 1986.

Harrow, Anita J. A Taxonomy of the Psychomotor Domain: A Guide for Developing Behavioral Objectives. New York: David McKay, 1972.

King, Franklin. Lesson Plan Format. Maryland Heights, MO: LaMP Co., 1605 Parklawn Ct., Columbia, MO 65201, 1975.

Krathwohl, D.R. (Ed.). Taxonomy of Educational Objectives: Handbook II, The Affective Domain. New York: David McKay, 1964.

Simpson, Elizabeth. J. The Classification of Educational Objectives, Psychomotor Domain. (Tech. Rep. Contract. No. 5-85-104. Urbana, IL: University of Illinois, 1966.

Squier, Terry. (Ed.). Directory of Curriculum Guides and Other Key Resources. Reston, VA: International Technology Education Association, 1985.

Wright, Thomas & Sterry, Leonard, et al. Industry and Technology Education. Chicago, IL: Technical Foundation of America, 1981.

Wright, Thomas R. & O'Rear, Pat. Industrial Technology Educational Curriculum - Rationale and Structure. Muncie, IN: Ball State University, 1985.

Chapter III

Implementing the ITE Program

I. Introduction

Implementing -- Implementing is making it happen. It involves moving the instructor's dreams, aspirations and hopes into reality. And in ITE the only reality that counts is what happens with students in our laboratories.

- Theory doesn't count,
- Hopes and wishes don't amount to anything and
- Intentions are of little value.

What actually happens to the youth in our charge is what counts -- it is our only reality. Our challenge is to make this reality match our professional goals and build a sound curriculum. Chapter II detailed how such a curriculum could be built. But there is more to success than just having a good curriculum -- particularly in ITE programs. We need proper technological facilities, up-to-date equipment, ongoing maintenance, a systematic safety program and a public relations program. Together these implement a sound program that makes dreams become reality.

Facilities are a big part of ITE. They can certainly contribute to the success or failure of a program. By themselves, however, facilities either good or bad, are seldom sufficient to make or break a program. Instructors face one of two situations with respect to facilities:

- They can find themselves in an existing facility that they will have to live with -- although renovation is always possible.
- They can find themselves involved in establishing brand new facilities.

Most instructors will find the former to be the case and part 2 of this chapter addresses this situation. Consequently this guide will also emphasize this section. However, the principles involved in planning new facilities, provided in this chapter's part 3, also apply to the planning of renovations. Thus, both parts 2 and 3 of this guide will be useful to instructors seeking to enhance their program.

Trends in ITE Facility Design and Equipment

There is a clear trend towards the establishment of cluster laboratories in industrial technology education. Often such facilities are large enough to allow sub-division by partitions (as long as building codes are maintained!) that divide comprehensive laboratories into more specialized facilities. For example, a comprehensive materials and processing laboratory may be sub-divided into unit laboratories for areas such as manufacturing, construction and materials testing. Similarly, an energy & power facility may be divided into fluidic, engine and electronics laboratories or a communication laboratory may be divided into unit facilities for visual, audio and telecommunications.

Today the best new facilities are provided with modular utility systems that enhance flexibility by easeing rearrangement of the laboratory when needed. Also important to flexibility is the use of portable equipment and tool storage. Roll-around cabinets, carefully tailored storage systems, and tables are often used to tailor instruction in varying areas of the facility.

Modular and table-top technology equipment are found much more frequently in today's facilities as are industrial design-based signage systems and bright colors. Multiple activity areas are used to give contemporary facilities a "laboratory" look as contrasted to yesterday's "shop." Of course cleanliness has much to do with this but so does the choice of bench-top and flooring materials. Colorful plastic laminates are prevalent and commercial carpeting is not at all inappropriate for some areas.

More and more simulators, trainers and computers are used to address the challenges of new technology. Generally instructors are turning to smaller equipment and less multiples of any single item. Instead, a greater variety is purchased in order to help students develop a better appreciation of the tremendous breadth of today's and tomorrow's technology.

Types of Industrial Technology Education Facilities[1]

When looking at the profession's activity across the nation, it seems clear there is a trend toward cluster courses in industrial technology education. These are typically implemented in three distinct kinds of ITE laboratories. They are: the comprehensive laboratory, the cluster laboratory and the technological specialization laboratory.

Comprehensive Laboratories. The comprehensive laboratory is a single facility designed and equipped to permit instruction in each of industrial technology's three key clusters. The size of the facility may vary depending on the number of instructors and students to be accommodated. This is the facility type recommended for schools with only one laboratory. Such a facility is specifically designed to permit broad, exploratory work in each major technology: materials & processing, communication and energy & power. Each of these cluster areas may be further subdivided if space is available. This type of facility is desirable at both the junior and senior high school level.

Cluster Laboratories. The cluster laboratory is designed for instruction in a single technological cluster. Within this cluster, various sub-specialty areas (e.g. finishing rooms, dark rooms, etc.) are implemented so that activities may be carried in reasonable depth. This design is recommended for large junior high schools and senior high schools with multiple laboratories. Cluster laboratories need to comprehensively cover the technology's major areas, e.g., a materials & processing facility would need to provide for plastics, metals, woods and ceramics equipment. Typically, schools would set up three such cluster laboratories in order to cover the range of technology. This arrangement also permits offering exploratory experiences by rotating students through one cluster laboratory after another during the school year. Such facilities may also be utilized for short-term adult courses.

Technological Specialization (Unit) Laboratories. The technology specialization laboratory is designed for in-depth instruction in one area of a technology. Examples of technology specialization laboratories include machine shops, construction, graphic arts and electronics laboratories. This kind of laboratory is the least effective with respect to the overall objectives of industrial technology education. However, these facilities are more appropriate to providing in-depth experiences related to vocational and "capstone" programs at the upper grade levels in high school. It is recommended only for a senior high schools with large enrollments that justify more than three laboratories.

---

[1] Adapted from Stallsmith, Douglas D. Guidelines for Planning Industrial Education Facilities and Equipment. Bulletin No. 9176. Madison, WI: Wisconsin Department of Public Instruction, 1977.

2. Updating Existing Facilities

How does one best update an ITE program? Certainly the curriculum recasting outlined in chapter II is an important start. However, another important dimension is the facility in which the curriculum is taught. Furthermore, facility updating is often the easiest and most effective means of injecting new life and excitement into an older, perhaps even stale, program. Because facility changes are so visible even relatively small improvements will often have significant effects on students, colleagues and administrators. It is amazing to see what a robot, a computer, or a new machine can do.

Teachers should not imagine that facility updating necessarily demands great investment. To the contrary, often a coat of paint or simple reorganization of existing resources will accomplish much of what is desired. Only after reorganization has reached its limits does rennovation need to be considered. Even this however, is not to be feared for much can be accomplished with relatively minor expense. Examples might include such things as opening a doorway between two adjacent laboratories, adding an outdoor area for construction or alternative energy activities, establishing a darkroom and the like. Schools have a large investment in existing facilities and with some work, most of these could be reworked to provide the type of facility needed to support a quality ITE program.

Reorganization

Reorganization of facilities is the easiest and least expensive way to program updating. Often it is what administrators need to see before they are convinced that the teacher is serious about program improvement. Once this becomes clear, increased levels of support typically follow.

In some cases extensive remodeling may not be necessary. Instead a reorganization of existing space will meet the demands of a new curriculum approach. Many laboratories are not making maximum utilization of available space. Space may be opened up by rearranging machines and equipment. Flexibility may be obtained by providing flexible hose connections to exhaust outlets and connecting flexible plug-in power modules. Integrating the woods, plastics and metals areas into a materials and processes laboratory may be done by adding a doorway between areas. New color code schemes, removing obsolete equipment and converting large benches into smaller units to form different configurations are a few more ways to be used in making an improved facility without great expense. The key to modernization is looking closely at what is already available rather than starting into a large, expensive major renovation or a new facility. (emphasis added)

• • •

Figure III-1 shows a small junior high school lab which was limited in space thus restricting the possibility of giving the students a new program based on a study of industry. The space was only large enough to handle basic woodworking as it existed. With a few minor changes the area became more open and flexible as well as adding some plastics, metals, graphic arts and a planning center. A clean area for communication technology and planning was created with some 10 foot high walls equipped with extensive glass areas to facilitate class control. A closet was converted into a darkroom and overhead space was used for mezzanine storage of supplies and infrequently used tools. Table top technology systems (CNC, plastics, desktop publishing, ...) were added to broaden the once narrow curriculum.

Additional reorganization amounted to the removal of some walls and the addition of overhead service systems. Each of the large bench units was split in half to provide work areas throughout the laboratory. The bench units became work modules which could be moved anywhere in the laboratory to form different work area configurations. It was not necessary to provide a lecture space in this shop because it could be done in a separate room (adapted from Stallsmith, 1977, pp. 30-40)."

Perhaps the nation's outstanding example of what can be accomplished by modernization is shown in Figure II-2. This two-teacher facility was created from a pair of traditional industrial arts woodworking and small engine shops. A complete description of this facility and curriculum overhaul can be found in the February 1987 issue of The Technology Teacher (pp. 23-30) and instructors are encouraged to review their approach in depth.

Renovation

Before beginning facility renovations, instructors are advised to use the Missouri ITE Standards provided in Chapter VIII's part 3, to assess their facility's current status. This will provide an excellent base of information upon which to plan the renovation of instructional facilities. To establish the necessary base it is recommended that ITE teachers:

1. Use the Missouri ITE standards to assess the existing facility's strengths and weaknesses with respect to the curriculum they have planned as per Chapter II.

2. Analyze the program's safety requirements.

3. Assess the technological relevance of their facility.

4. Consider the requirements of the various media (VCR, slide-tape, film, self-instructional carrels, computer) they wish to use to deliver instruction.

5. Consider team teaching and its facility implications.

6. Review the requirements of their instructional and facility management systems.

7. Consider the facility's visual impact and public relations effect.

Wisconsin's facility guidelines[1] highlight another most important concern in the planning process, namely the student. "If the student's needs and concerns are not recognized the basic purpose for which the facility is planned will be defeated. A facility should motivate the student to learn and become aware of what this environment has to offer. It should be a laboratory for learning with action-oriented experiences that enable students to understand the relationship of school work to the world in which they live (p. 1). Facilities must also be capable of evolving to support the learning activities of technologically driven curriculum revisions and expansions.

Instructors need to consider the possibility that the laboratory will have to be multi-purpose in nature -- that it will need to be transformed from one type to another. For example, a need may arise for the laboratories to be used during the day by students and to provide community access during the evening hours. The industrial technology education facility of the future must be one where change is not only possible but practical. In order to accomplish this, change must be planned into the facility design

Instructors must always remember that ITE facilities need to be versatile instructional settings and not simulated industrial facilities. Consequently these facilities must be able to respond to whatever setting the curriculum content and/or method demands. The students may be working on individual problems, research, working as a team on a problem, or participating in the process of mass production from product design to product distribution.

Wisconsin's guidelines state "There is no one formula for evaluating facilities. It is suggested that if the total estimated cost of modernization is 50 percent or less of the estimated cost of replacement, it is wise to re-evaluate the old facilities (27, p. 151). It is not practical to put money into a structure for which more money will have to be spent again in a few years. . . . A primary question that should be asked is whether the facility, when updated, can house the required educational program. If the answer is "no" then the facility should be replaced. If new facilities are out of the question, old facilities may be updated to serve the objectives of the program. On the other hand, the old facilities may be so outdated that it becomes difficult to implement a program regardless of remodeling. . . .

---

[1] The MOITE Guide development team appreciatively acknowledges Wisconsin's permission to cite and adapt their material as needed.

The problems of modernization vary greatly. The school enrollment may have outgrown the old facility or new courses may be wanted and needed which cannot be taught in existing facilities. Perhaps the existing structure is not capable of being remodeled because of safety and/or provision for the handicapped author requirements. Safety code requirements differ from city to city and should be thoroughly understood before a final decision is made to build or modernize. For instance, in some cities the regulations require that the entire building must be brought up to code if any part of the building remodeled or touched by a new addition. This can bring about an added expense which may be the key factor in deciding that building a new facility would be more economical . . .

Improvements often place the responsibility upon the teacher and not on consultants or architects. Some of the critical factors in considering improvements are: reorganizing present space for maximum utilization, the addition of new learning experiences, improvement of safety conditions, providing better utility services and providing better flexibility so courses may be better interrelated (Stallsmith, 1977, p. 38).

Space Management

"Change, as it affects physical facilities, can be controlled through a process known as "space management." It is the art and/or science of managing people, time and money to most effectively use available space. In a school, it is the process of matching students' learning needs (curriculum) with the components of learning (space, tools, aids), placing them within a time frame (schedule) and doing this all within an allotted budget. (10, p. 1)

• • •

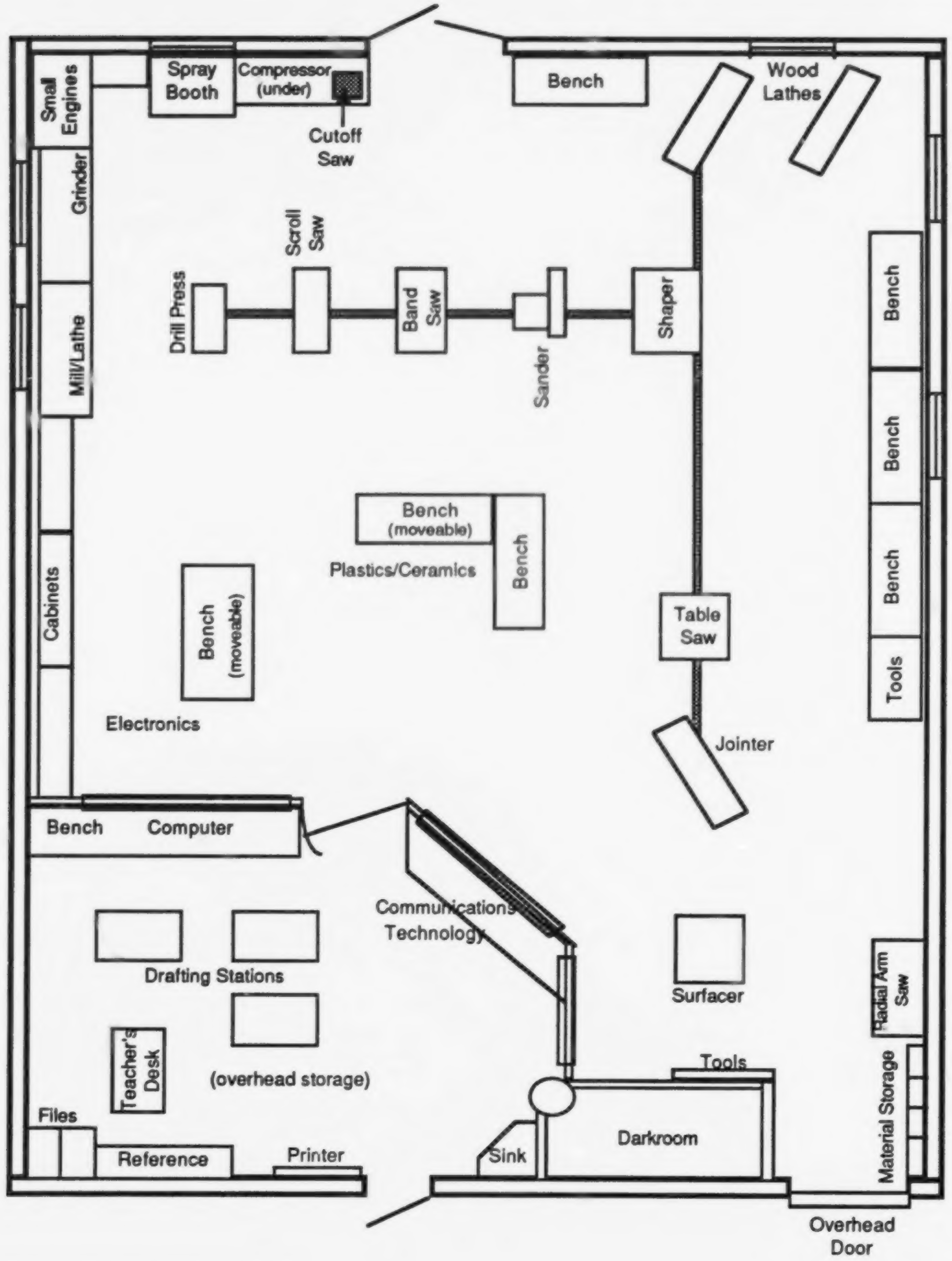
Space management is not difficult when there is an awareness of the techniques of space manipulation. All space must be inventoried for its suitability as learning space. There must be an awareness of the space requirements of the various tasks to be accommodated, a knowledge of the manipulable elements available and an appreciation of the costs involved in such changes.

• • •

The easiest space to manipulate, of course, is totally unencumbered space. It may be necessary that the entire space allocated in the existing school for industrial technology education be cleared of all non-load-bearing walls in order to start with an unencumbered space. It is then possible to begin reallocating space according to the curriculum. It may be found that an addition to the present structure is justifiable, especially if the program calls for an expanded curriculum (Stallsmith, 1977, pp. 38-39)."

Figure III-1

Updated Industrial Technology Education Laboratory[1]

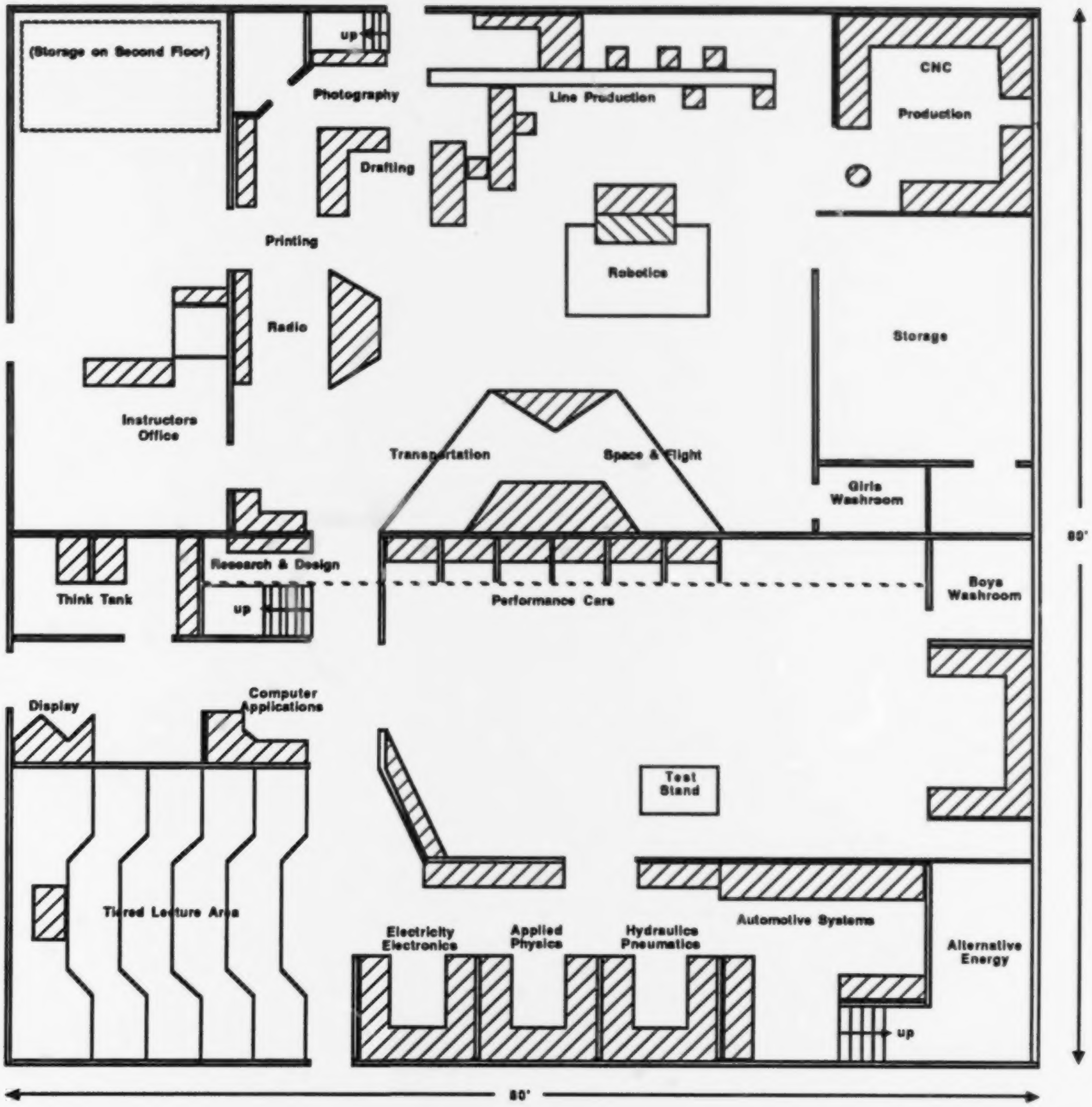

Small Engines
Spray Booth
Compressor (under)
Cutoff Saw
Bench
Wood Lathes
Grinder
Scroll Saw
Drill Press
Band Saw
Sander
Shaper
Bench
Mill/Lathe
Bench
Bench (moveable)
Bench
Plastics/Ceramics
Bench
Cabinets
Bench (moveable)
Table Saw
Tools
Electronics
Jointer
Bench
Computer
Communications Technology
Drafting Stations
Surfacer
Radial Arm Saw
Teacher's Desk
(overhead storage)
Tools
Material Storage
Files
Reference
Printer
Sink
Darkroom
Overhead Door

---

[1] Stallsmith, 1977.

Figure III-2

Technology Education Laboratory
Pittsburg Middle School, Pittsburg, KS


(Storage on Second Floor)
up
Photography
Line Production
CNC
Production
Drafting
Printing
Robotics
Radio
Storage
Instructors Office
Transportation
Space & Flight
Girls Washroom
Research & Design
Think Tank
up
Performance Cars
Boys Washroom
80'
Display
Computer Applications
Test Stand
Tiered Lecture Area
Electricity Electronics
Applied Physics
Hydraulics Pneumatics
Automotive Systems
Alternative Energy
up
80'

Another actual example of reorganization was published in a School Shop[1] article, "Knocking Down the Walls to Set Up for Tech-Ed," Dillenbeck (1986). It provides an excellent case study that makes the point for renovation, and also how to accomplish it, extremely well:

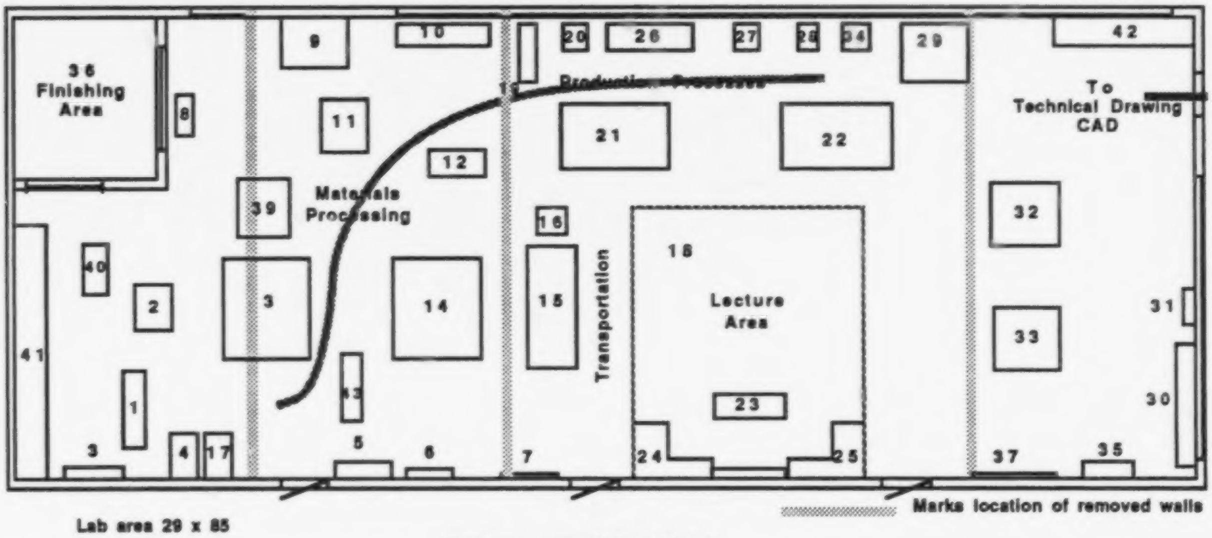
> Under industrial arts we had nice, neat little spaces for each course. Metals instruction took place in the metals shop, woodworking in its space, graphics in its area and so on, even down to finishing in the finishing room. Conversely, technology by its very nature calls for a blending or overlapping of these traditionally separate areas. To show a continuance of processes in the production of goods or the interrelationship of skills, machines and resources, you should have an open laboratory.
>
> Different areas of the technology laboratory must retain their own special characteristics, such as electricity/electronics or transportation, but the entire facility must show enough flexibility to accomodate use as needed by other technology content areas. While in theory this may not be that hard to accomplish, a major drawback rests with the concepts that we have inherited from industrial arts, where each shop has stood by itself. These concepts go back to days when we were comfortable and when space, curriculum and financial restrictions figured in less than they do today.
>
> To survive effectively with new programs, we must be able to consolidate space and create new open arrangements so that our students can see the big picture and so that processes can flow easily from one course section to another.
>
> Specific plans. As depicted in Figure III-3, the central area of the laboratory forms the lecture/information area. A teaching bench, which doubles as the teacher's desk, stands in front of 16 folding desk chairs. Behind the teaching bench, blackboard space and the areas on either side of the blackboard provide an information center with books, planning materials, magazines and other resources. If the folding chairs are not needed during laboratory production, they can be removed for extra floor space.
>
> The rest of the facility is designed around this central area. Each individual area forms a large triangle in which equipment is placed, with one point reaching to the lecture/information area. This format keeps student movement to a minimum. For example, with the students working on an electronics project, lessons and planning take place in the lecture/information area, laboratory work on component assembly occurs in the electricity/electronics area and construction work on the printed circuit and case for the project takes place in the end of the metalworking area closest to the electricity/electronics area. The students are thereby confined to an organized section of the laboratory that suits their current project.
>
> Another example of such triangulation of activities lies between the lecture/information center and the metalworking area. The concept of production unfolds in the move from metal cutting to fabrication, to assembly and finally, to finishing.
>
> Conversely, all areas can combine in the study of such broad concepts as transportation. Work on small engines takes place on a bench with engines secured to it on metal stands. After completing small engine work, a student can move to model working on an electric car -- the engines are stored and the student benches then serve as a site for fabrication processes.
>
> While the lecture area makes a natural teaching center, the wood benches or the electricity/electronics benches can also be used for such purposes, since each area has a blackboard. Tool panels are located on the walls in each area and floor tool cabinets serve locations without walls.

---

[1] The MOITE Guide development team appreciatively acknowledges Prakken Publication's permission to reproduce this article.

Figure III-3

Renovated ITE Laboratory[1]


36 Finishing Area
8
9
10
11
12
39
Materials Processing
40
2
3
14
41
1
43
3
4
17
5
6
19
Production Processes
20
26
27
28
34
29
21
22
16
15
Transportation
18
Lecture Area
23
7
24
25
42
To Technical Drawing CAD
32
33
31
30
37
35
Lab area 29 x 85
Marks location of removed walls

Design Considerations

1. The area will accommodate an average-size class of 16 students
2. The area will allow for a total view of the facility by the instructor
3. The area will provide lecture area and laboratory area sufficient to provide a basic three-unit sequence of TE
4. The area will provide for interaction between its individual facility areas.
5. The area will be adaptable to accommodate change and program revision.
6. The individual laboratory facility areas of woodworking, metalworking, transportation and electricity/electronics will be designed around a triangular structure. Individual pieces of equipment and the lecture area will form a triangular area for ease of movement by the students and instructor.
7. Within the individual facility areas, machinery and laboratory equipment will be arranged to provide for ease of material flow during production operations.
8. Written material will be easily accessible to students as will computer utilization for drawing and planning.

Legend

1. Wood lathe
2. Band saw
3. Wall tool panel
4. Jigsaw
5. Sink
6. Wall tool panel
7. Blackboard
8. Belt sander
9. Welding area bench, tanks, and arc welder
10. Metal soldering table with furnace
11. Table saw
12. Jointer
13. Wood bench with lockers
14. Wood bench with lockers
15. Small engine bench with lockers
16. Tool chest
17. Wood drill press
18. Lecture area
19. Spot welder
20. Grinder
21. Metal bench with lockers with roll form
22. Metal bench with storage with brake and shears
23. Teacher lecture bench
24. Bookcase/information area
25. Bookcase/information area
26. Metal lathe
27. Metal drill press
28. Tool cabinet
29. Squaring shears
30. Bench with lockers
31. Sink
32. Electrical bench with lockers
33. Electrical bench with equipment storage
34. Metal tool and hardware cabinet
35. Wall tool panel
36. Finishing area
37. Blackboard/bulletin board
38. Blackboard/overhead screen
39. Surface planer
40. Radial arm saw
41. Wood supply rack
42. Metal supply rack
43. Wood rack -- shorts

---

[1] Dillenbeck, 1986.

Materials and equipment are stored in each laboratory area where students can have easy access -- when materials are needed they are at hand. Equipment requiring ventilation goes at one end of the laboratory to ease in the construction of a ventilation system. Electrical connections are made by ceiling drops to benches and equipment.

A computer should be located in the lecture/information center. However, the computer-assisted drafting/design system, along with the administrative computer area, should be located in the technical drawing section, next to and accessible from the laboratory. Such equipment is sensitive and requires a clean area.

The equipment included in this floor plan can provide a multitude of student laboratory experiences in technology education. Areas are generally flexible enough to permit use in processing a wide variety of materials. The overriding key is that enough variety in equipment has been located in each area so that students' talents can be maintained consistently under the integrated notion of technology education. Obviously, instructors can make additions or variations to suit their special needs.

The important lessons that can be learned from this kind of a case study include:

- The facility should be space saving, efficient and student centered. Use space wisely -- any excess or unused space can weaken your program. The facility must serve the students, since their education is always the prime concern.
- A good computer-assisted drafting/design system is critical for the future of technical drawing. . . . We have five stations, each involving a state-of-the-art computer with state-of-the-art CAD software.
- Association with other curriculum areas can strengthen our technology education program and also help save other curricula which may be in danger. Instead of moving us to a building left by our failed agriculture program, our district chose to have us transform the industrial arts laboratory into the technology education facility and then placed an agriculture laboratory next to us. This will form a solid occupational center, capable of attracting students to our main building.
- You must let people know your ideas and opinions concerning proper facility planning. Do this without delay. If you do not present your concepts for change, no change will take place. The speed at which educational redesign can occur is phenomenal.
- Your technology education program or course of study must be up to date. You cannot plan for future facilities with an old industrial-arts-style program. . . .
- Stress safety in all planning activities. Safety is always a concern and the more you address it in your planning the safer your overall facility will be.
- Don't consider the removal of walls a great obstacle. Educators tend to think of taking out a wall as a drastic procedure, but remodeling contractors can easily plan and execute such removals. The increased safety and efficiency is well worth the effort.

The primary lesson learned from all of this the the importance of teacher planning. The teacher's input concerning requirements for a good facility must be made clear to all parties -- particularly to the administrative folks who regulate facility changes. Write everything out and submit it as quickly as possible. The total elapsed time for our initial planning was 11 weeks from the time I was first told that changes would be needed to the point when the school officials accepted our facility-change proposals.

In that period, floor plans were made and remade, alternatives discussed, equipment lists and potential suppliers developed, studies made on CAD systems and the necessary wall removals and other facility changes detailed. I presented in writing all necessary information so that the administration could study and understand the kind of facility that we needed and how it would best serve the students in our technology education program. (Page 45-47, School Shop, April 1986)

3. Planning New Facilities

Overview of the Process

The curriculum is the base for facility planning. This must be emphasized because facilities must reinforce the goals of the curriculum -- this is the key to a successful facility. Beginning here is equally important when planning new facilities or when modernizing of existing facilities.

Often, it is desirable to establish a local industrial technology education program planning committee to help design the facility. Candidates for such a committee include: industrial education teachers, local supervisors, local administrators,state or university consultants and a representative, preferably from industry, of the local program's advisory council. Committee members should be well aware of the local school situation and should be provided with reference materials which will aid in the planning. Wisconsin's guidelines suggest such information should include: state accreditation standards, related local and state laws and regulations, school philosophy and goals, an outline for preparing educational specifications, trends in industrial education and estimated construction and equipment funds available (Stallsmith, 1977, p. 5).

• • •

Overall, there are two distinct phases in the facility planning process -- Phase One, in which the proposal is made ready for approval and Phase Two, in which the approved proposal is transformed into detailed drawings, construction and equipment acquisition. The steps within these phases are:

Phase One

1. Determining key ITE facility design criteria
2. Deriving educational specifications from the curriculum to be implemented
    - Space needs
    - Auxilary spaces
    - Space relationships
3. Interaction with the architect

Phase Two

4. Euipment layouts
5. Construction
6. Acquisition of equipment and materials
7. Installation of equipment
8. Ongoing evaluation and modifications

Determining Design Criteria

A basic, "but often violated, principle of facility planning is that the facility should be developed to accomplish the objectives of the program. Decisions concerning philosophy, goals and instructional program to be implemented must be made during this step of the planning sequence. (Stallsmith, 1977, p. 5)"

Educational Specifications

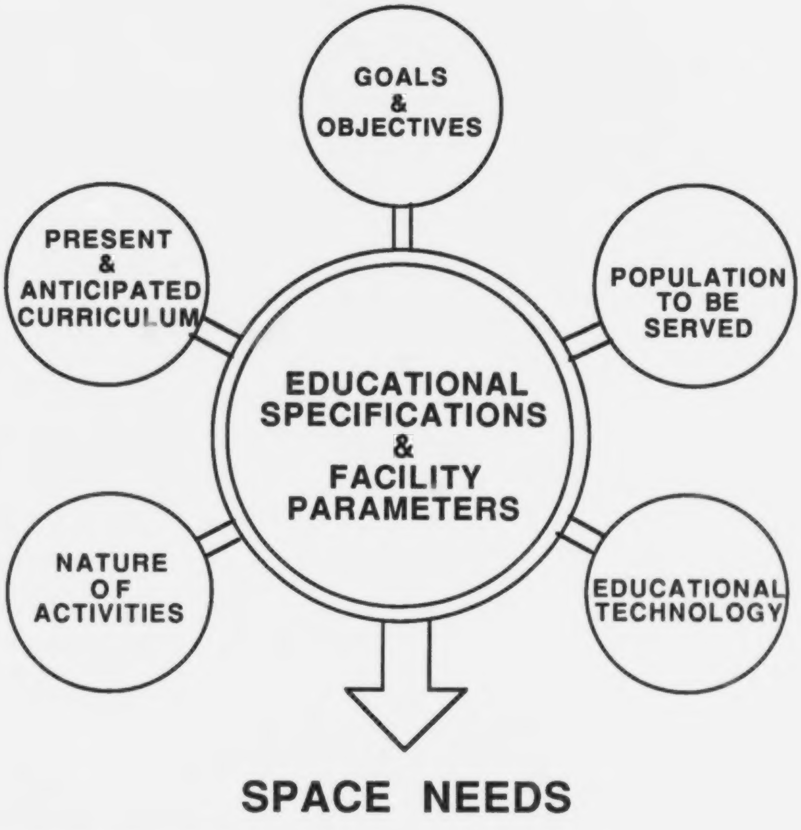
Educational specifications derive from the ITE program's scope and sequence. "Once the course levels and sequences have been established, a description and brief outline of each course to be offered in the program may be developed. The content outline will be a guide to selecting activities and equipment. It will also aid in determining space allocation, number of teachers required and scheduling of courses. (Stallsmith, 1977, p. 5)"

An overview of factors to be considered when developing educational specifications is given in Figure III-4. Wisconsin's guidelines state "Educational specifications are detailed descriptions and standards which may serve as a basis for facility requirements. They must be the vehicle of communication between the educators, administrators and the architect. (They) . . . give the architect a rationale on which to base his design. Justifiable (sic) statements describing the needs should be written for such items as space needs, space relationships, color schemes, lighting, electrical, exhaust, acoustical and communication systems. (Stallsmith, 1977, p. 6)" Figure III-5 suggests a format for, and content of, educational specifications.

"Educational specifications are a critical part of the planning process. The more detailed and complete they are the more likely they will be useful to the architect. The architect will be able to transfer these specifications into a preliminary layout with a minimum of design changes. Change orders are many times difficult to implement once construction has begun. If compromises and size reductions have to be made such action must be taken with full knowledge of the effect on programs. A complete set of educational specifications provides the best guide when compromises and reductions must be made. (adapted from Stallsmith, 1977, p. 6)"

Figure III-4[1]

Educational Specifications Overview


GOALS & OBJECTIVES
PRESENT & ANTICIPATED CURRICULUM
POPULATION TO BE SERVED
EDUCATIONAL SPECIFICATIONS & FACILITY PARAMETERS
NATURE OF ACTIVITIES
EDUCATIONAL TECHNOLOGY
SPACE NEEDS

---

[1] Bender, 1978, p. 4.

Figure III-5

Educational Specifications Outline[1]

I. 1 Philosophy

  A. State the philosophy and goals of industrial technology education.
  B. State the objectives of the industrial technology education program.

II. Instructional Program

  A. Summarize the scope and sequence of courses to be offered in the industrial technology education program according to grade level.
  B. List the courses by title and give a brief description of their content.
  C. Give a short description of the types of teacher and student activities to be implemented in each facility.

III. Space Needs

  A. Estimate of school enrollment.
  B. Estimate of industrial technology education enrollment (youth & adult).
  C. Use class size estimates to calculate the number of class sections necessary.
  D. Determine square footage per laboratory and auxiliary areas.

IV. Equipment

  A. Layout for each laboratory, where fixed and movable equipment will be located.
  B. Give quantity, name, size, floor space (including operator space) and utility requirements for each major piece of equipment.

V. Auxiliary Space

  A. List requirements for each kind of auxiliary space.
  B. List equipment for each auxiliary area.

VI. Environmental Considerations

  A. Specify by laboratory and auxiliary space.
  B. Specify visual, auditory, air, utility, safety, handicapped access/accommodation, ventilation and structural requirements.

VII. Space Relationships

  A. Sketch block or bubble diagrams showing relationship of industrial technology education area to other areas of the school.
  B. Sketch diagrams relating areas within industrial technology education to each other.

---

[1] Adapted from Stallsmith, 1977, p. 75.

Space Needs

Once the instructional program is defined and the scope and sequence of courses established, space needs should be established as a vital part of the educational specifications. School and industrial technology education enrollment, class size, number of class sections, the balance between required and elective courses, availability to boys and girls, amount and nature of equipment and student/teacher activities to be implemented must all be weighed in determining space. Although each school is different and therefore it is necessary to estimate space according to the local conditions, there is a minimum size for laboratories of given types.

Some guidelines suggest that "a figure of 25 per cent of the school membership be used to determine the number of students which will elect industrial technology education courses." Obviously, however, this depends on the school's program policies and consequently the 25% figure can range from 25% to 100%. To calculate the space required, the estimated enrollment then needs to be multiplied by the square foot per student allocations for each technology area as recommended in Tables III-1 and III-2. For example: For a junior high school materials & processing laboratory, using a middle-of-the-road 100 square feet per student standard, and an estimate of 20 students/class, yields a general area requirement of 2000 square feet.

Planners need to keep in mind that "there are three basic space requirements which should be considered. They are: (1) station allowances -- space for basic machines, teaching system, work area for students around machines, and . . . safety clearance; (2) station circulation burden -- general circulation allowance within that area of the laboratory containing stations, such as aisle space and traffic patterns; (3) general circulation -- space allowance for general support facilities, such as clean up and future expansion. This last space category usually amounts to about 25 percent of the total of (1) and (2) (3, p. 11) (Stallsmith, 1977, pp. 6-7). The space allocations recommended in Tables III-1 and III-2 are minimums for industrial technology education programs. Professional judgement suggests they work best with class sizes of 15-24.

Table III-1

Space Recommendations for[1] Industrial Technology Education Facilities: Grades 7-8

Technology Focus of Course	**Existing Facilities*** Recommended Minimum Safe Area (Square Feet per Student) (Approx 80% of new facility)	**New Facilities*** Recommended Design Standard For a Class of 24 Students (Minimum Area and Utilization)
General Data (Applies to all laboratories unless listed differently)	The maximum number of students per class period is equal to the existing floor area divided by the safe square feet per student. recommended below	Office 100 sq.ft. • Supply Storage 5% area • Material storage 5% area • Student storage 10% area • Resource Center 5% area • Class Discussion 15% area
Introduction to Technology or General Laboratory	75-135 sq. ft. per student	4000 square feet inclusive Dust free area for Comm. area • Dark room 5% area • Bench 15% area • Machine 15% area • Processing 15% area
Exploration of Technology General Laboratory	100-135 sq. ft. per student	4000 square feet inclusive Dust collection system • Bench 15% area • Machine 10% area • Processing 25% area
Introduction to, & Exploration of, Technology (Combined) General Comprehensive Laboratory	166 sq. ft. per student	5000 square feet inclusive Multi-activity facility

---

[1] The square foot per student figure is to be used for initial space needs estimate. The result then needs to be adjusted to align with the specialty space minimums that detail each general estimate.

Table III-1, Continued

Space Recommendations for Industrial Technology Education Facilities: Grades 7-8

Technology Focus of Course	**Existing Facilities*** Recommended Minimum Safe Area (Square Feet per Student) (Approx 80% of new facility)		**New Facilities*** Recommended Design Standard For a Class of 24 Students (Minimum Area and Utilization)	
Communication Technology Laboratory	53-118 sq. ft per student overall		1600 square feet plus	
	• Visual Communication area	1500 sq. ft.	Dust-free atmosphere	
	• Audio Communications area	900 sq. ft.	• Dark room	20% area
	• Darkroom	150 sq. ft.	• Machine	5% area
Energy & Power Technology Laboratory	50-150 sq. ft. per student overall		1600 square feet plus	
	• Mechanical work area	600 sq. ft.	Fume exhaust system	
	• Electrical work area	600 sq. ft.	• Bench	20% area
	• Fluidics area	600 sq. ft.	• Machine	15% area
	• Propulsion area	600 sq. ft.		
	• Storage area	400 sq. ft.		
Materials & Processing Technology Laboratory	80-135 sq. ft. per student overall		3200 square feet inclusive	
	• Main processing area	1500 sq. ft.	Dust collection system	
• Manufacturing	• Material storage	600 sq. ft.	• Bench	15% area
• Construction	• Student Project storage	400 sq. ft.	• Machine	15% area
	• Finishing room	150 sq. ft.	• Processing	20% area
	• Small equipment storage	150 sq. ft.		
	• Construction fabrication & installation area	1800 sq. ft.		
	• Design & develop area	300 sq. ft.		
	• Storage areas	600 sq. ft.		

* Facility is used here to identify a single laboratory or educational space for a course.

Additional recommended space for all: Multi-purpose classroom 900 sq. ft., Office area (per teacher) 100 sq. ft. minimum.

The total area of laboratories is determined on the basis of square feet per student and an assumed class size of 15-24 students. The square feet/student ratio is not valid for very small class sizes in that typically a minimum area is necessary for adequate learning and work.

These recommendations listed were derived from publications issued by the states of Idaho, Missouri, North Dakota, North Carolina, Oklahoma, Wisconsin and Texas.

Table III-2

Space Recommendations[1] For Industrial Technology Education Facilities Grades 9-12

Technology Focus of Course	**Existing Facilities*** Recommended Minimum Safe Area (Square Feet per Student) (Approx 80% of new facility)	**New Facilities*** Recommended Design Standard For a Class of 24 Students (Minimum Area and Utilization)
General Data (Applies to all courses unless listed differently)	The maximum number or students per class period is equal to the existing floor area divided by the square feet per student recommended below	Office 100 sq. ft. • Supply Storage 5% area • Material storage 5% area • Student storage 10% area • Resource center 5% area • Class discussion 15% area
Technology Systems (All 3 Technologies taught in one facility) General Laboratory	166 sq. ft. per student	5000 square feet inclusive (multi-activity facility) Each technology area in the facility to meet or exceed the requirements listed above.
Multi-activity Facility Any two courses taught in one facility	Add the sq. ft. per student for each area and multiply the total by .75	Add the square feet for each and multiply the total by .75 Each course area in the facility should meet or exceed the requirements listed above.

---

[1] The square foot per student figure is to be used for initial space needs estimate. The result then needs to be adjusted to align with the specialty space minimums that detail each general estimate.

Table III-2, Continued

Space Recommendations for Industrial Technology Education Facilities: Grades 9-12

Technology Focus of Course	Existing Facilities* Recommended Minimum Safe Area (Square Feet per Student) (Approx 80% of new facility)	New Facilities* Recommended Design Standard For a Class of 24 Students (Minimum Area and Utilization)
Communication	66-158 sq. ft. per student overall	2000 square feet inclusive
Manufacturing Graphics	Communications laboratory	(single area facility)
Construction Graphics	• Visual Comm. system 1500 sq. ft.	• Dust-free atmosphere
Engineering Graphics	• Audio Comm. system 900 sq. ft.	• Dark room - G.C. 10% area
Graphic Communication	• Audio-visual systems 600 sq. ft.	• Dark room - Photo 20% area
Electronic Communication	• Darkroom 150 sq. ft.	
	• Radio Ham station 50 sq. ft.	
	• Storage area 600 sq. ft.	
Energy and Power	100-187 sq. ft. per student overall	3000 square feet inclusive
Energy Systems	Power/Energy Laboratory	(Single area facility)
Energy and Power	• Mechanical energy area 800 sq. ft.	Dust-free atmosphere
Electrical Systems	• Electrical energy area 800 sq. ft.	Fume exhaust system
Electronics	• Propulsion systems 1500 sq. ft.	• Work surfaces 15% area
Computer Applications	• Storage areas 600 sq. ft.	• Machine space 15% area
Transportation Systems		
Materials and Processes	133-170 sq. ft. per student overall	4000 square feet inclusive
Production Systems	• Machine processing 3000 sq. ft.	(single activity facility)
Manufacturing Systems	• Project storage 300 sq. ft.	Dust & fume collection
Construction Systems	• Fabrication area 2500 sq. ft.	• Materials storage 8% area
Research and Development	• Production planning 500 sq. ft.	• Student storage 12% area
	• Assembly area 400 sq. ft.	• Planning area 5% area
	• Finishing room 200 sq. ft.	• Bench 15% area
	• Storage areas 500 sq. ft.	• Machine 15% area
	• Fabrication area 2000 sq. ft.	• Processing 15% area
	• Erection area 1000 sq. ft.	
	• Design area 500 sq. ft.	
	• Storage areas 600 sq. ft.	

*Facility is used here to identify a single laboratory or educational space for a course.

Additional recommended space for all: Multi-purpose classroom 900 sq. ft., Office area (per teacher) 100 sq. ft. minimum.

The total area of laboratories is determined on the basis of square feet per student and an assumed class size of 15-24 students. The square feet/student ratio is not valid for very small class sizes in that typically a minimum area is necessary for adequate learning and work.

These recommendations listed were derived from publications issued by the states of Idaho, Missouri, North Dakota, North Carolina, Oklahoma, Wisconsin and Texas.

Auxiliary Spaces

In order for ITE facilities to work effectively, suitable auxiliary spaces are absolutely necessary. These include storage areas for tools, materials and projects, finishing rooms, darkrooms, office space, classrooms and many others as facilities become more specialized. "These spaces should be planned separately but in relationship to the main laboratory. . . . Specifications for each auxiliary area should be very explicit and include all necessary accessories, such as lighting, electrical, ventilation, exhausting, built-in features, shelving and built-in cabinets. (Stallsmith, 1977, p. 8)"

"An instructional area (class size) and resource center should be planned within or near the industrial technology education department. It should be adjacent to the main work areas for easy access and partitioned preferably with glass walls for proper supervision. Proper layout can make the instructional area accessible to several main work areas. . . .

"In smaller schools where fewer sections are scheduled, the classroom may be designed as a multi-purpose room. It may serve as a planning center, resource center, technical library and may be used for small group discussions as well as a classroom. Normally, this area may have a lower ceiling height providing a mezzanine for potential storage overhead. . . . (Stallsmith, 1977, p. 8)"

Storage areas should be adjacent to, but separated from, the main work area. They must be designed to form an integral part of the laboratory's operation. "Large storage areas should be provided for such materials as lumber, metal, plywood, sheet metal, hardboard and plastics. Doorways into storage areas must be positioned correctly so the materials may be moved in and out easily. This positioning is also related to the location of vertical or horizontal racks to be used inside the room. The number of racks will be determined by the quantities of materials needed during the year. These rooms should also be located near where deliveries are made and close to the first processing operations to eliminate, as much as possible, material handling. When designing a new facility there are many items of storage which may be built-in and the cost absorbed in the building contract. For example, a darkroom sink or fixed lumber racks should be included in the cost of construction and not taken from the equipment budget. (Stallsmith, 1977, p. 8)"

A finishing room, free of dust, should be provided adjacent to the materials & processing laboratory. It is recommended that visibility be provided for instructor supervision of the area. It is extremely important to check local fire regulations and building codes regarding requirements for a finishing room. These codes usually require explosion-proof electrical fixtures and exhaust fans ducted to the outer atmosphere. A filtering system should be provided. Fire resistant finishing cabinets must be used for storage for all flammable liquids. In some cases, only a limited amount of flammable or combustible liquids may be stored in the finishing room. A fire extinguisher must be located within ten feet of the door leading into where these liquids are stored. If a spray booth is provided it must meet the regulations and be properly filtered and connected to an exhaust system. For safety reasons, the fume exhaust on the spray booth should have an automatic cut-off when the air flow drops below an unsafe level. Also it is recommended that an automatic sprinkler system be installed in the finishing room. It is also a good idea to provide drying shelves or racks. (Stallsmith, 1977, p. 8)"

"The office area should provide a space for the instructor to plan and organize the instructional program. It should also be semi-private for counseling of students. It is preferred that the office(s) be located near the laboratory for easy access to needed materials. Offices should be equipped with a desk, chair, planning table, file cabinets, bookshelves and a telephone. (Stallsmith, 1977, p. 9)"

Space Relationships

"The shape of the spaces and their relationships to each other, and to other areas of the school, are equally important. The shape may vary from square or rectangular to other geometric shapes, but more important are maximum efficiency in traffic patterns, safety, clustering of areas, flexibility and good supervision. Any shape which does not permit complete visibility for the instructor from any position in the laboratory should be avoided. (Stallsmith, 1977, p. 9)"

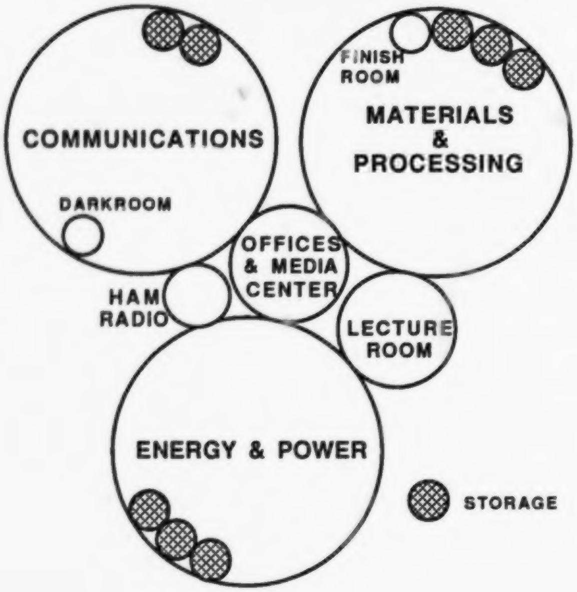
Along with the recommended floor layout, "the planning committee should submit in addition to a recommended layout to the architect, a relationship chart that shows the relationships and sizes of spaces using bubble diagrams or space relations diagrams." Figure III-6 shows such a chart. "These diagrams should illustrate the relationship of the industrial technology education department to other areas of the school, relationships of each laboratory to all others and the relationships of auxiliary areas within each laboratory. The architect will have the responsibility of interpreting the specifications and providing preliminary layouts showing the relationships in more detail. Teachers can assist in placement of equipment following the approval of the preliminary layout of the laboratories. (Stallsmith, 1977, p. 10)"

The industrial technology education department is an integral part of the total school building and should be designed this way. It is normal to position the laboratories on the perimeter of the building because of materials deliveries, the need for large overhead doors and sound control but they should not be designed as an appendage to the main school building. As an integral part of the educational program, they should be easily accessible to other areas of the school so interdepartmental activities may be implemented.

"Individual laboratories within the industrial technology education complex should be placed should be placed in positions for the best physical arrangement and most effective intradepartmental activities. Layout should be such that it is not necessary to pass through one laboratory to get to another. (Stallsmith, 1977, p. 10)"

Figure III-6

Space Relationship Chart[1]



---

[1] Stallsmith, 1977, p. 9

Interaction with the Architect

Instructors and school system administrators are encouraged to work for an active role in the development of new facility plans. This means that the teacher should be afforded the opportunity to interact with the architect who will design the new facility. This is important because architects are usually not expert in the requirements of the technological curriculum nor are instructors expert in school architecture. What is needed is the systematic blending of the two expertise areas. This can only come through face-to-face discussion. Mere paper, or even cursory oral communications, will just not achieve the desired ends.

Equipment Layout

"Once the architect has completed preliminary plans showing position and size of spaces to be included, placement of equipment may begin. This is especially important to the architect so he/she can visualize where the mechanical services are going to be needed throughout the facility. (Stallsmith, 1977, p. 12)"

Equipment must be properly positioned to allow a normal sequence of operations with a minimum student movement. Movable equipment will aid in proper positioning and encourage special activities such as production lines. "Semi-permanent positioning of the equipment will enable proper positioning of electrical bus ducts, exhaust systems, air lines and lighting. Generally since materials move from storage to machines for sizing, to bench fabrication or processing, to finishing, this order should be followed for proper layout of materials and processing facilities whenever feasible. Machines must always be positioned to permit safe operation, material handling, maintenance and sufficient aisle space between machines so traffic flow does not interfere with machine operations. Similarly, the direction of lighting should be considered to reduce shadows on working surfaces." The use of scale model equipment or templates can be very helpful in determining the optimum arrangement of the laboratory equipment such as shown in Figure III-7. (Adapted from Stallsmith, 1977, p. 10)

"It is essential that equipment lists and equipment layouts become a part of the specifications so the architect has some idea of proposed mechanical requirements and design layout features to be desired in the preliminary layouts. While it is not necessary to list hand tools and pieces of equipment which will be stored in cabinets, it is necessary to list all those items which require floor space. (Stallsmith, 1977, p. 8)"

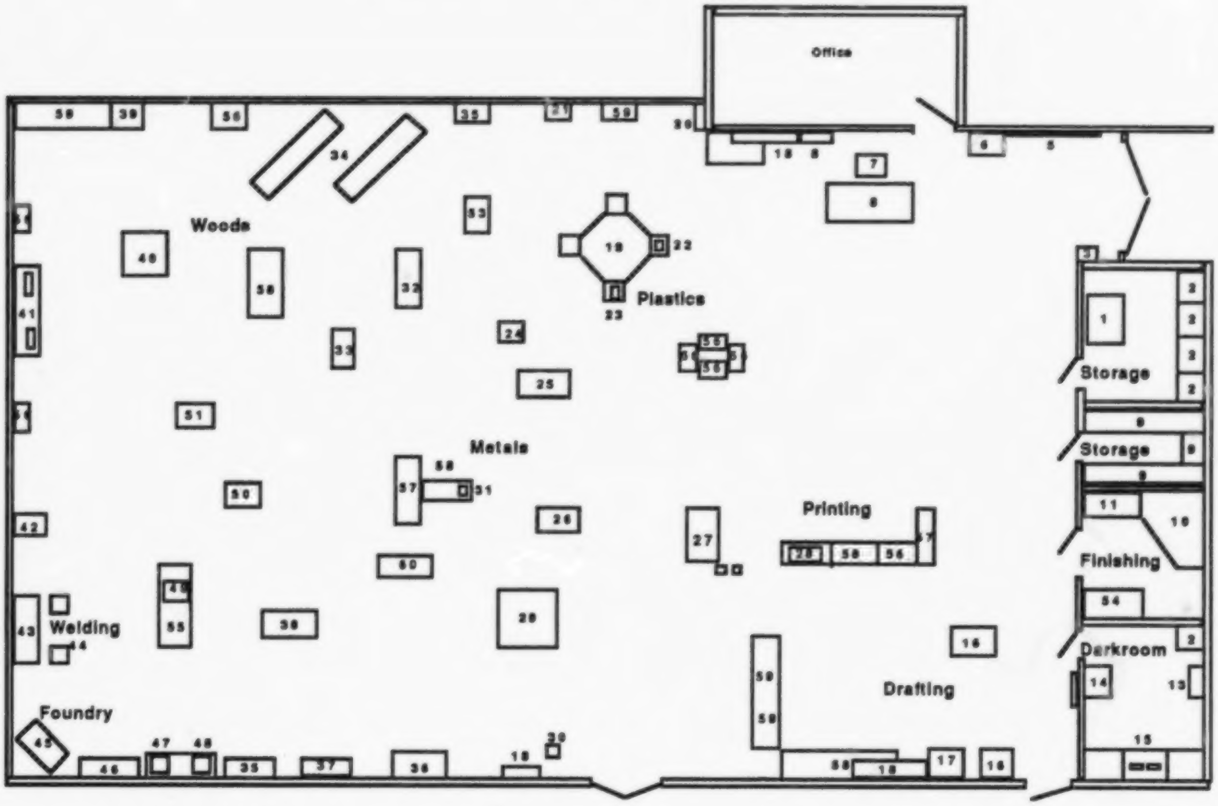
"The equipment list should be separated by rooms and by fixed or movable categories. Information needed for each piece of equipment is the floor space required and utilities required. It is not as detailed as required for requisitioning, but it must be sufficient to provide the architect enough information for effective layout and to provide for adequate and safe operating space. It will also provide the architect with information regarding flexibility and location of utilities necessary for the laboratory. (Stallsmith, 1977, p. 8)"

Construction

During the construction the ITE instructor should maintain contact with the architect and contractor on the progress of the building or remodeling. Often there emerge electrical, plumbing or other questions that need clarification that only an instructor familiar with the ITE program can provide.

Figure III-7

Sample Laboratory Equipment Layout[1]



1. Vertical metal storage
2. Horizontal lumber storage
3. Time clock
4. Chalkboard/screen
5. Bulletin board
6. File cabinets
7. Desk & chair
8. Display cabinets
9. Storage cabinets
10. Spray booth
11. Finishing cabinet
12. Refrigerator
13. Enlarger, photo
14. Vertical camera
15. Sink
16. Drafting tables
17. Light table
18. Wall tool cab.
19. Bench unit
20. Material samples
21. Materials tester
22. Injection machine
23. Vacuum former
24. Thermoformer
25. Powdered metals
26. Metal shaper
27. N/C machine
28. Offset
29. Roller/shear
30. Bender
31. EDM
32. Jointer
33. Surfacer
34. Wood lathe
35. Tool cab.
36. Box/pan brake
37. Lathe/miller
38. Vert./hori. bandsaw
39. Radial saw
40. Table saw
41. Grinders
42. Wood welder
43. Arc/gas welder
44. Arc welder
45. Crucible furnace
46. Foundry unit
47. Bench furnace
48. Bench oven
49. Drill press w/ automatic feed
50. Bandsaw
51. Comb. belt/disc sander
52. Printer and developer
53. Drill press
54. Finishing bench
55. Bench w/stake plate
56. Benches
57. Benches
58. Benches
59. Benches

---

[1] Stallsmith, 1977, p. 13

Acquisition of Equipment and Materials

Immediately following approval of expenditures work must begin on the actual acquisitioning of equipment and materials. This typically is the responsibility of the industrial technology education teachers or supervisors who will be working in each of the laboratories. If the equipment list formulated during the development of educational specifications was done well, this step should be relatively easy. "It is also recommended to place a priority ranking on each equipment item for each laboratory. This becomes quite useful if equipment and material budgets are reduced for any reason." (adapted from Stallsmith, 1977, p.14).

Installation of Equipment

This part of the process takes considerable organization on the part of the industrial technology education faculty in order to be ready to receive and position all equipment upon delivery. Again, lead time is critical if the equipment is to be inventoried, installed and checked out before the school year begins. It is recommended that the school system assign a team of plumbers, carpenters, electricians and painters to the ITE facility setting up the laboratory. In this way the set up will be facilitated and administrative workload will also be reduced. (adapted from Stallsmith, 1977, p. 14)"

"One industrial technology education teacher should be responsible for checking all equipment orders as they are received so they can be cross-referenced with the purchase orders. After equipment deliveries have been checked, a receiving report should be sent to the school business manager. The items can be inventoried and the boxes marked as to which laboratory area they are to be moved into for installation or storage. Placing each item on inventory cards saves time later because all the necessary information is available. See Figure III-8 for a recommended inventory card to use during this stage.) (Stallsmith, 1977, p. 14)"

"Using the equipment layout generated in the educational specification step will provide for easier placement of equipment as it arrives in the laboratory. All equipment needing utility connections should be placed in position immediately to enable maintenance personnel and/or contractors to make proper hook-ups. Once utilities are connected, the teacher should thoroughly check out the operation of the equipment and note any discrepancies so they can be reported to suppliers for adjustment. (Stallsmith, 1977, p. 14)"

"Some suppliers of technology equipment provide installation service. The industrial technology education teachers should be aware of this service, if provided, and contact the supplier when equipment is needed for installation. It is also important that any guaranty or warranty cards received with the equipment be filled out and returned to the supplier or manufacturer as soon as possible. For easy reference, the customer copy of the guaranty or warranty should be filed with the inventory cards. (Stallsmith, 1977 p. 14)"

Figure III-8

Sample Equipment Record Card[1]

(Front)

EQUIPMENT INVENTORY CARD

Item Name: ____________________

Description: ____________________

____

Serial No.: ____________________ Location: ____________________

Date	By	Condition	Date	By	Condition	Date	By	Condition

(Back)

Purchase Order No.: ______ Date: ______ Received: ______ Cost: ______

Supplier: ____________________ Warranty Period: ____________

Preventative Maintenance Schedule

Maintenance Activity	Weekly	Monthly	Annually

Maintenance Record

Date	Maintenance Activity

---

[1] Adapted from Stallsmith, 1977, p. 15.

Evaluation and Modification of Equipment and Facilities

Planning, evaluating and re-organizing should take place continually if an industrial technology education laboratory is to remain an up-to-date environment for learning. This should take place annually. The ITE teacher "in each laboratory must play a key role in detecting any defects in equipment or building to assure that proper commitments have been met between the school system and contractor or suppliers. Discrepancies should be noted and reported so that alterations may be made before guaranties and warranties expire. Many times minor changes may be found desirable after a laboratory becomes operable. These modifications should be noted and changes made, if practical, so as to provide a better learning environment. (Stallsmith, 1977, p. 14)"

Sources of Funds

In the state of Missouri the burden of facility construction and remodeling of elementary and secondary schools lies largely with local school districts. No general programs of federal financial support for school construction have been developed. However, the Carl. D. Perkins Vocational Education Act of 1984 does provide the opportunity for Federal construction funds for occupational programs.

"Alternatives may be available for financing school facilities but each state may vary on the legality of using certain methods. School districts should have a financial and legal consultant for this part of the planning project. These alternatives are suggested by the Educational Facilities Laboratories. (36) (Stallsmith, 1977, p. 27)"

- Pay as you go financing
- State aid, e.g. the ITE grant awards program
- Federal aid
- Shared facilities
- Non-tax revenue
- Bond issues
- Leasing

Sample Facility Designs

To stimulate the facility design process, a few sample design from around the nation have been selected and shown in Figures III-9 through III-14. All could house Missouri's recommended ITE program well. However, instructors should consider these plans only as idea sources, not as state recommendations. Additional facility planning details can be obtained from the documents listed in this chapter's part 8 (Resources).

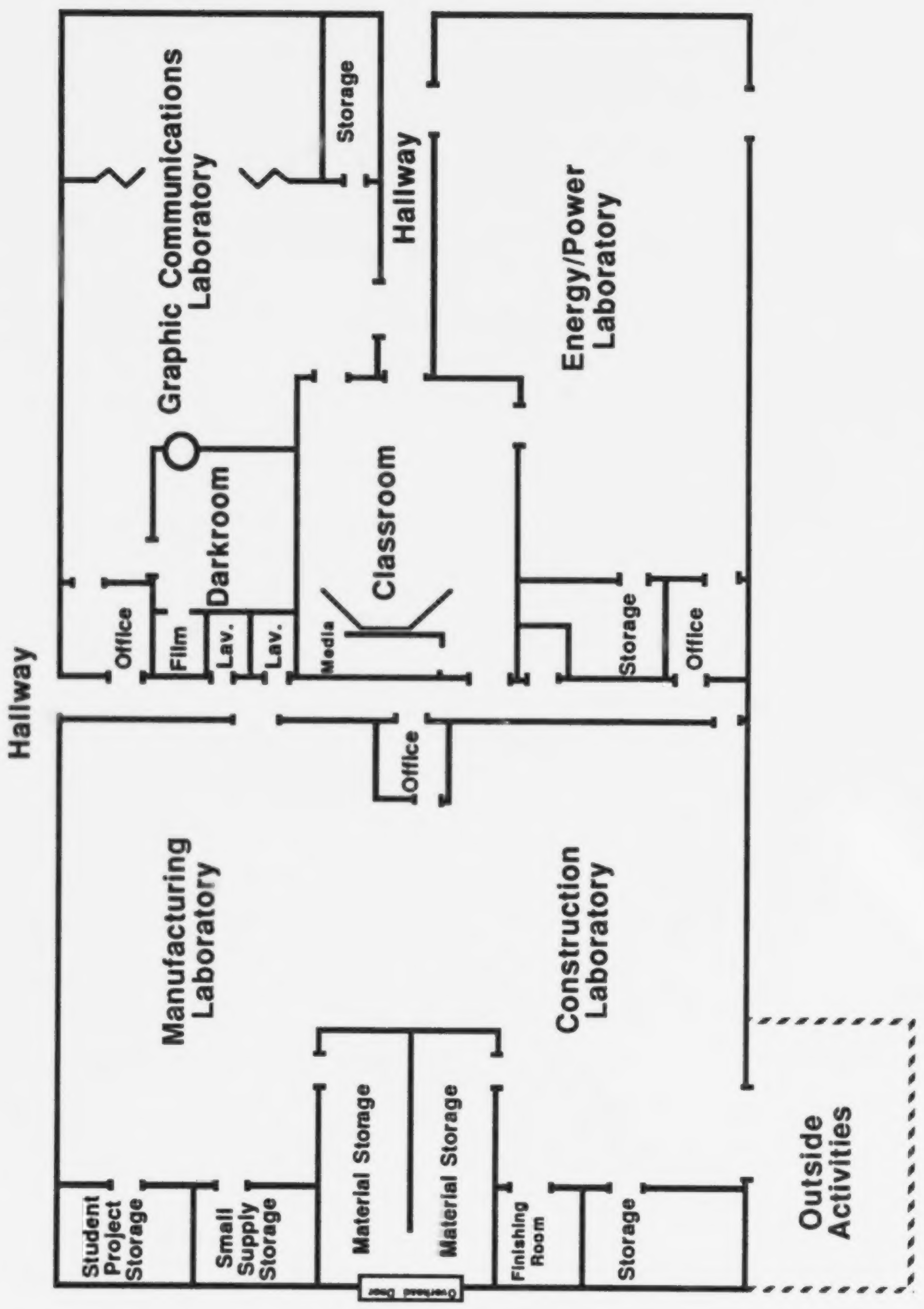
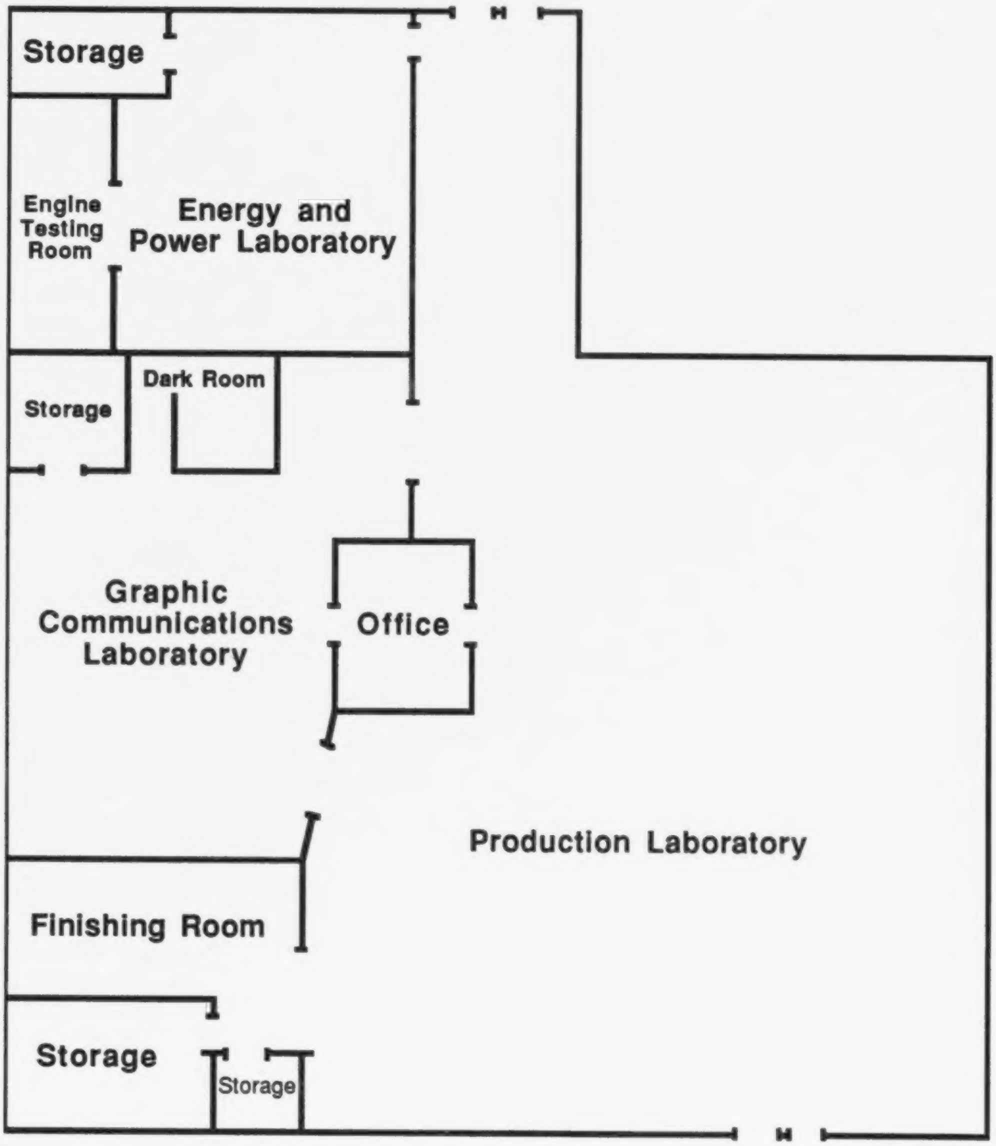

Hallway
Graphic Communications Laboratory
Storage
Hallway
Energy/Power Laboratory
Darkroom
Classroom
Office
Film
Lav.
Lav.
Media
Storage
Office
Office
Manufacturing Laboratory
Construction Laboratory
Material Storage
Material Storage
Student Project Storage
Small Supply Storage
Finishing Room
Storage
Overhead Door
Outside Activities

Figure III-9 Sample JHS or Small SHS ITE Facility

Figure III-10

Wood River JHS, Hailey, Idaho[1]

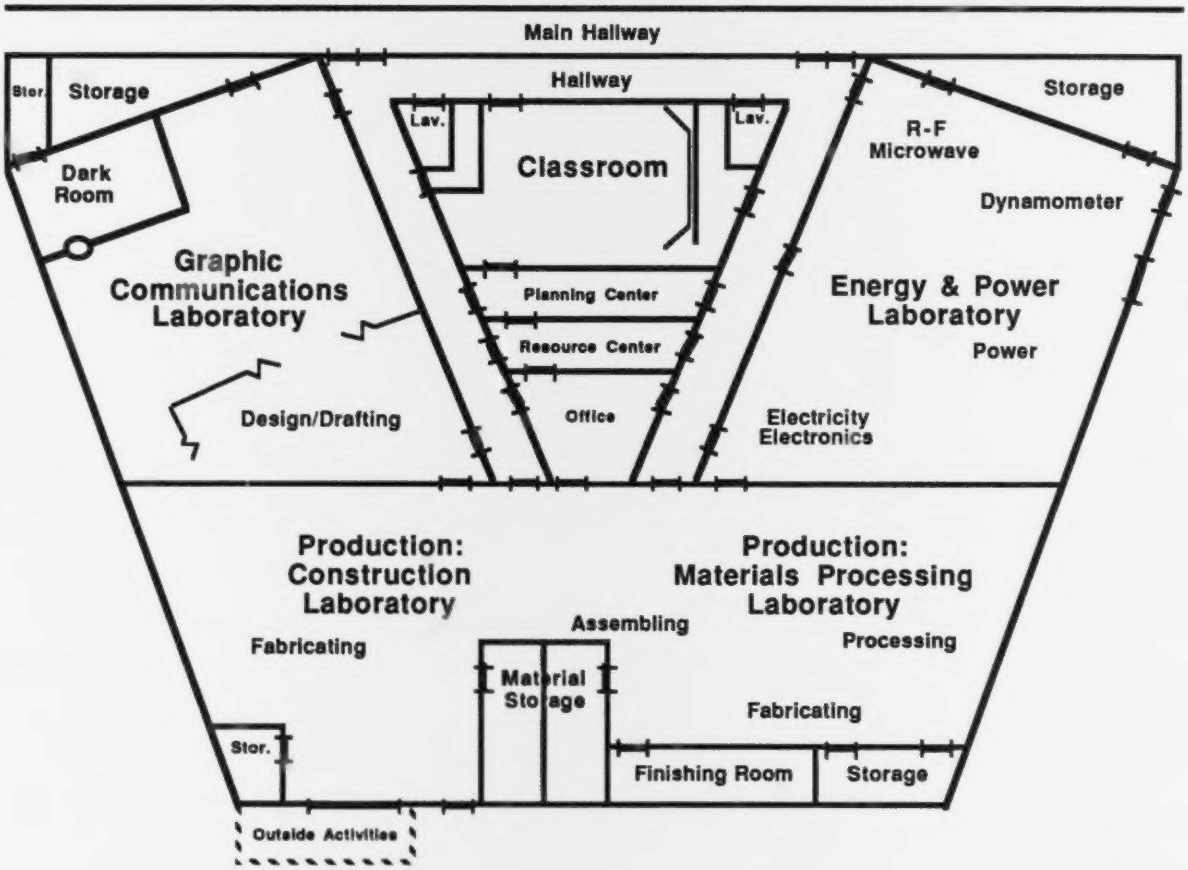

Storage
Engine Testing Room
Energy and Power Laboratory
Storage
Dark Room
Graphic Communications Laboratory
Office
Production Laboratory
Finishing Room
Storage
Storage

---

[1] Bender, 1978, p. 52.

Figure III-11

Sample SHS ITE Facility (North Dakota)[1]



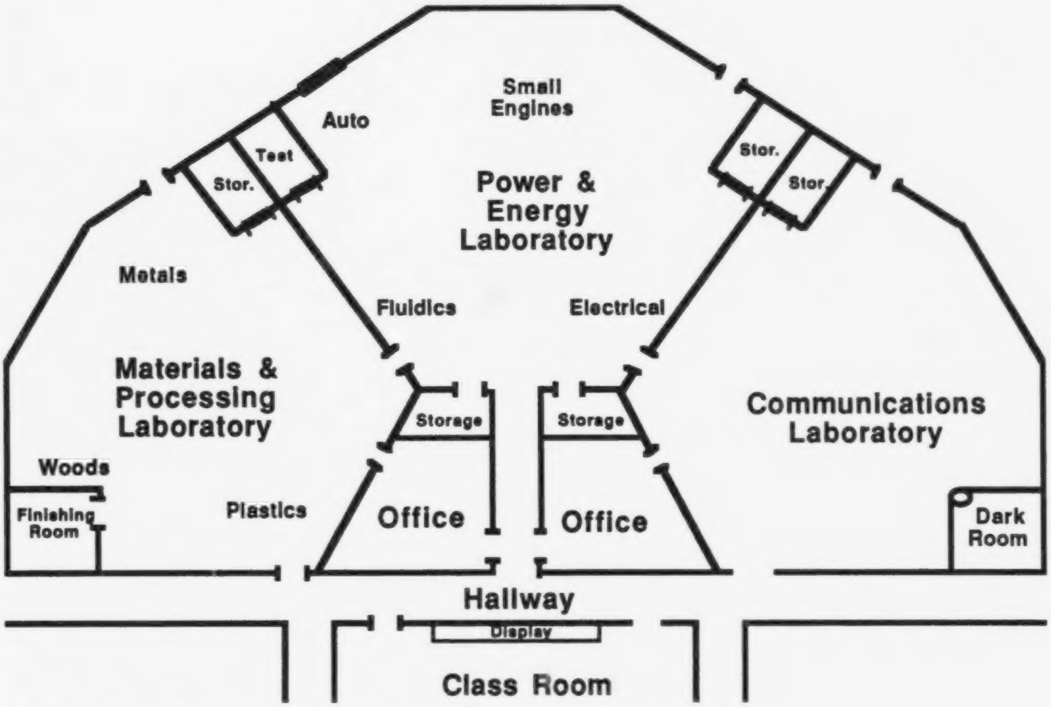
Main Hallway
Hallway
Stor.
Storage
Dark Room
Lav.
Classroom
Lav.
R-F Microwave
Storage
Dynamometer
Graphic Communications Laboratory
Planning Center
Resource Center
Office
Design/Drafting
Energy & Power Laboratory
Power
Electricity Electronics
Production: Construction Laboratory
Fabricating
Assembling
Production: Materials Processing Laboratory
Processing
Material Storage
Fabricating
Stor.
Finishing Room
Storage
Outside Activities

---

[1] Bender, 1978, p. 61.

Figure III-12

Sample SHS ITE Facility -- Wedge shaped (Wisconsin)[1]

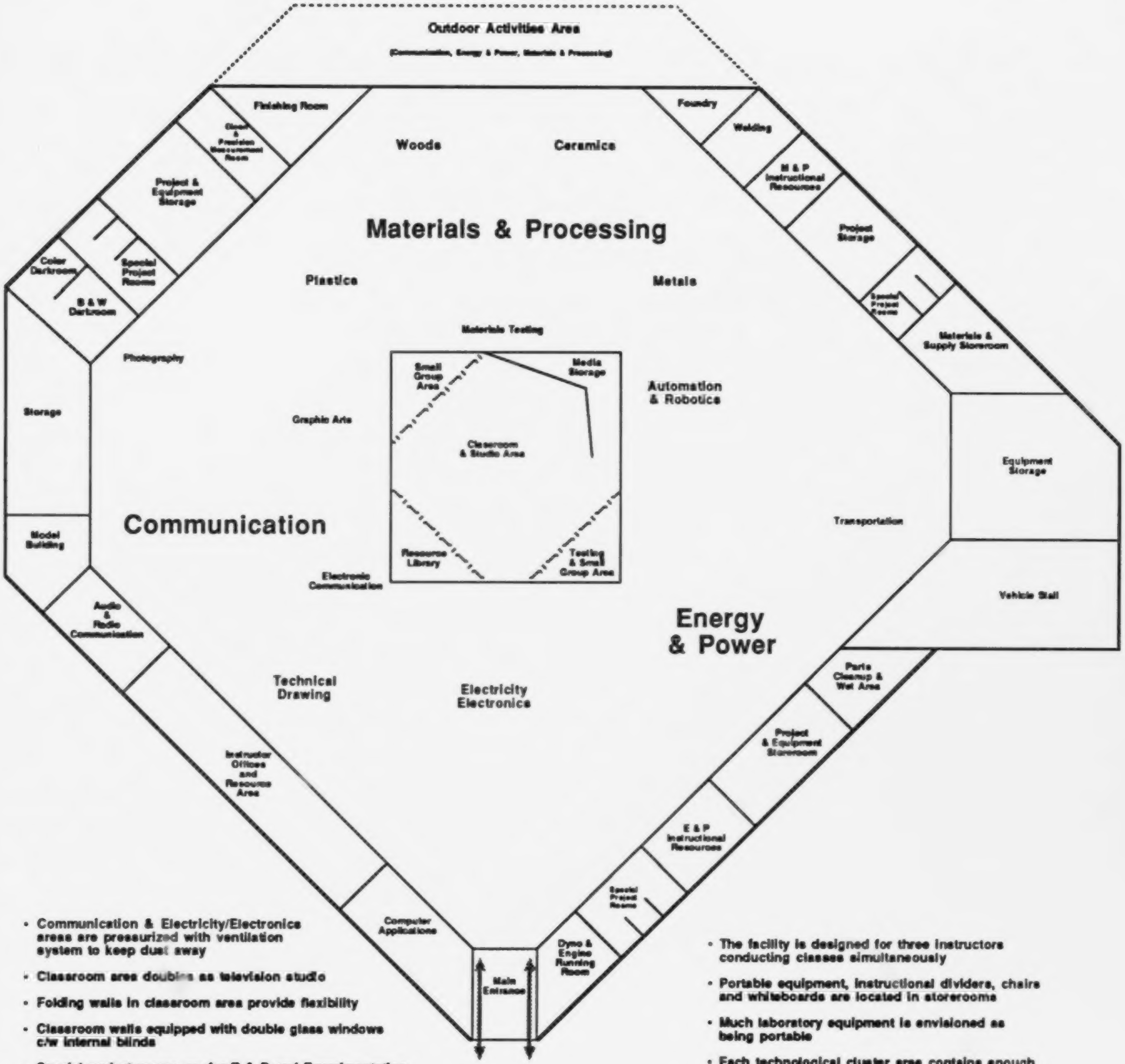

Small Engines
Auto
Test
Stor.
Stor.
Stor.
Power & Energy Laboratory
Metals
Fluidics
Electrical
Materials & Processing Laboratory
Storage
Storage
Communications Laboratory
Woods
Finishing Room
Plastics
Office
Office
Dark Room
Hallway
Display
Class Room

---

[1] Stallsmith, 1977.

Figure III-13

Model Cluster-Based Industrial Technology Education Facility


Outdoor Activities Area
(Communication, Energy & Power, Materials & Processing)
Finishing Room
Clean & Precision Measurement Room
Project & Equipment Storage
Special Project Rooms
Color Darkroom
B & W Darkroom
Woods
Ceramics
Materials & Processing
Plastics
Metals
Foundry
Welding
M & P Instructional Resources
Project Storage
Special Project Rooms
Materials & Supply Storeroom
Materials Testing
Small Group Area
Media Storage
Classroom & Studio Area
Resource Library
Testing & Small Group Area
Photography
Storage
Graphic Arts
Automation & Robotics
Equipment Storage
Communication
Transportation
Model Building
Electronic Communication
Vehicle Stall
Audio & Radio Communication
Energy & Power
Technical Drawing
Electricity Electronics
Parts Cleanup & Wet Area
Project & Equipment Storeroom
Instructor Offices and Resource Area
E & P Instructional Resources
Special Project Rooms
Computer Applications
Dyno & Engine Running Room
Main Entrance

- **Communication & Electricity/Electronics areas are pressurized with ventilation system to keep dust away**
- **Classroom area doubles as television studio**
- **Folding walls in classroom area provide flexibility**
- **Classroom walls equipped with double glass windows c/w internal blinds**
- **Special project rooms are for R & D and Experimentation classes and advanced students**

- **The facility is designed for three instructors conducting classes simultaneously**
- **Portable equipment, instructional dividers, chairs and whiteboards are located in storerooms**
- **Much laboratory equipment is envisioned as being portable**
- **Each technological cluster area contains enough space for simulation and enterprise activities.**

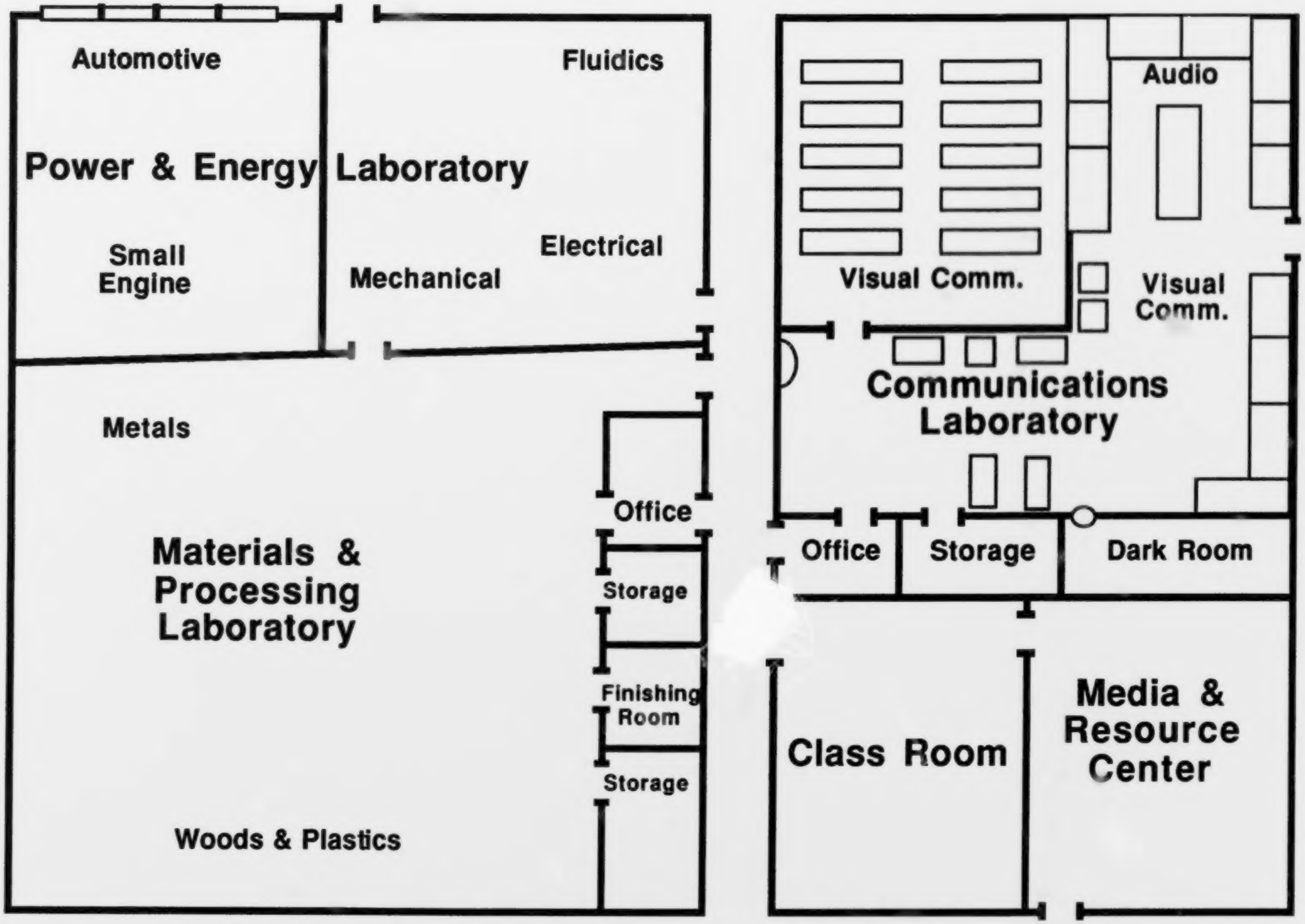

Automotive
Fluidics
Power & Energy Laboratory
Small Engine
Mechanical
Electrical
Metals
Office
Materials & Processing Laboratory
Storage
Finishing Room
Storage
Woods & Plastics
Audio
Visual Comm.
Visual Comm.
Communications Laboratory
Office
Storage
Dark Room
Class Room
Media & Resource Center

Figure III-14 Sample SHS ITE Facility -- Rectangular (Wisconsin)[1]

---

[1] Stallsmith, 1977

Notes:

4. Equipping the Program

The ITE instructor faces major responsibilities in equipping the ITE facility(ies). In doing so he/she must always keep in mind the often conflicting demands of safety, flexibility, relevance to curriculum and costs.

The Purchasing Process

The instructor must recognize that most major pieces of equipment, curriculum materials and software require cycling through a systematic purchase process. Usually this process involves:

- Securing purchase approval in principle.
- Developing detailed specifications for what is desired.
- Identifying alternative suppliers
- Securing specifications for desired equipment.
- Comparing supplier equipment to the desired specifications
- Developing a competitive bid in the form required by the school system
- Bidding the item.
- Selecting successful bidder.
- Securing final purchase approval.
- Ordering the item.
- Receiving the item.
- Installing and testing the item.
- Authorizing payment.

"Lead time is critical in ordering equipment. Requisitions should be completed well ahead of the deadlines for when they will be needed. Requisitions should be submitted to the school administration so purchase orders may be mailed out in time for delivery, installation and testing of all equipment before student utilization. Communication should be maintained with the vendors to determine the status of the orders and to notify vendors of changes in delivery dates if final construction plans are delayed. (Stallsmith, 1977, p. 14)"

Budgeting

It is recommended that ITE instructors work with their administrators to establish a budget for their program/course. In this way routine purchases can be expedited. However, long-range plans for the phased-in acquisition of equipment are needed to supplement the normal budget process. Typically such plans are used to achieve significant updating goals. They can also be used to attend to initial routine replacement process for worn-out/obsolete equipment, curriculum materials and software.

Donations

Instructors are well advised to make use of their industrial contacts and their ITE program advisory councils, for purposes of securing donations to hardware and supplies. Often this is an overlooked component in the supply side of the picture. Additionally organizations such as those listed in Chapter V can also be helpful. Because of the typical laboratory's space restrictions, it is recommended that one not accept equipment that will not meet course objectives. Of course, the exception is when permission is granted to use such donations as "trading stock" to get other more appropriate items.

Writing Specifications[1]

Just as the architect uses a graphic language to communicate an idea to the client and to the contractors, the instructor uses specifications as a vehicle to convey his/her thoughts to the school's administration and to the companies who will supply the school's needs.

It is therefore important that the specifications be sufficiently clear so as to remove all doubt about the items being sought. The information given should solve two problems. It should state enough characteristics such as size, model number, brand, etc. so that the specific application of the item is evident. Secondly, it should be detailed enough to rule out all known items of lesser quality that could be substituted to achieve a lower bid price. The three major participants in the specifications development process are the instructor, the administrator/supervisor and the vendor.

The Role of the Instructor. Above all, it is vitally important that the instructor be familiar with the range of available equipment and suppliers. During the last few years there has been a tremendous increase in the type of equipment available to teach all facets of industrial technology and many new vendors have emerged. Existing vendors have also broadened their lines as well. All of this has made it increasingly difficult for instructors to oversee. Clearly the easiest way to develop the vitally needed overview so that the most effective purchasing can occur is for instructors to attend the trade shows at the national conferences (AVA & ITEA). A few days there are invariably more valuable than months of magazine scanning.

The instructor bears the majority of responsibility for accurate specifications in that they are generally originated by him/her and he/she alone knows what is really wanted as well as what could be substituted. Instructors should consider the following hints as a guide for writing successful specifications:

- State quantity (each, dozen, gross, etc).
- Give product or manufacturer number (Model 1920 USRK).
- Choose a recommended supplier and give their catalog number. Most companies assign an index or computer number for an accurate and immediate reference. Be sure the recommended company is reputable and that the catalog is current.
- Give manufacturer's description. This sets the standard of quality you expect.
- Give name of item. ("Bosch cordless electric drill" - not just "drill").
- Specify size, kind, particulars, etc. Example. 3/8 inch cordless electric drill, reversible, variable speed, etc.
- Describe accessories such as guards, blades, switches, guides, etc. Many of the items are sold separately so a supplier needs to know if they are expected to be included in the price that is to be quoted.
- State whether alternatives may be substituted if approved as equal.
- Specify type of delivery expected:
    - Dock delivery (tail gate)
    - Inside delivery
    - Installed (not connected)
    - Fully installed and operational. Installation is not available from all suppliers. Some will install for an added charge depending on the complexity of the job.

---

[1] The MOITE Guide development team appreciates the assistance of Mr. David H. Thompson, District Manager, Brodhead Garrett Co. in developing this section.

- State whether the shipping cost is to be included in the bid price. If unspecified this can become an expensive surprise for the school.

- It is important that the ITE instructor establish and maintain credibility with his/her administration. Back up your request with supportive statements that show the need for the requisitioned item.

- Specify the services you expect with the product. For example: On-site service, shipping, delivery, installation, training, assistance in curriculum development, etc.

- Allow enough time for the request to be processed through the administration, and the bidding, ordering and delivery process.

The Role of the Administrator. Schools generally have a policy that requires the principal, business manager, or purchasing agent to review ITE instructor requisitions before ordering. There are three reasons why a careful examination should be made:

1. The request should be examined to see if it is "over-kill" or "under-kill" for the specific application for which it is to be purchased. This is in reference to size, quality and quantity. Some brands may be too light or too cheap to last while others may be too large for an educational application.

2. The request should represent a best possible price for the product and/or service needed. Additional bids may need to be solicited to determine whether or not the best value has been identified.

3. It is the administrator's duty to see that all school policies have been considered, i.e., school contracts with designated companies have to be honored, that orders are given to with good records of service, reliability and representation. Many Boards of Education encourage local purchasing when permissible to keep money in the community and/or to insure fast service.

The Role of the Supply Company (Vendor). The responsibility of the supplier is two-fold:

1. To meet the specifications which have been submitted with a product that will satisfy the requirement for minimum cost.

2. To assist the school by giving them the maximum quality for the money they want to invest.

Vendors are in a position to see new trends, new products and new applications because of their various contacts with manufacturers and educational leaders. Therefore, occasionally a company or representative will offer a suggestion of an alternative which may be a better value than that requested, or a quality level more appropriate to the application. This of course, has to be in advance of a formal bid or as an alternative bid. ITE instructors need to explore such opportunities when they arise.

Common Problems. Suppliers are often faced with problems on purchase requisitions. Requisitions should be carefully reviewed to be sure these problems do not apply:

1. Name and address of the proposed supplier(s) is omitted.

2. An old catalog is used for pricing for pricing and reference.

3. A requisition is submitted rather than an official purchase order.

4. The part number and/or stock number is omitted.

5. School administration approval of the purchase is not evident.

6. There is no clear policy at the school for receiving and signing for merchandise.

7. Desired items are not adequately described. Some examples and the problem questions that result are:

    EXAMPLE: 100' mahogany

    QUESTION: Board feet, or linear feet? Thickness? S2S, or rough? Genuine, or Philippine?

    EXAMPLE: Jig saw blades (6)

    QUESTION: 6 each, or 6 packages? Size of teeth? Pin end, or plain end? Size? Quality?

    EXAMPLE: 1 box screws 1" x #8

    QUESTION: Round head, or flat head? Straight slot, or phillips? Brass, black, or chrome? How many in a box?

8. Electrical data omitted.

    EXAMPLE: Electrical package

    QUESTION: 110, 220, or 280 volts? Single phase, or 3 phase? Horsepower? Controls? Magnetic or manual switch?

9. Accessories for equipment omitted.

    EXAMPLE: 1 band saw, complete

    QUESTION: Lamp? Guide? Extra Blades? Guard? Motor?

5. Maintaining Laboratory Equipment

Even the best facilities and equipment will surely deteriorate quickly if the instructor does not maintain them. Furthermore a lack of attention to maintenance sends a message to students and the problem quickly grows.

However, the positive side also works. Where it is obvious that the instructor cares about the laboratory, it is easy to instill a similar respect among the students. So, how does this occur? The following points are derived from the experience of many successful industrial arts/industrial technology education teachers:

1. Perform routine maintenance to prevent breakdowns.

   - Establish a preventative maintenance schedule for each machine
   - Enlist student help where it is safe and it contributes to goal achievement

2. Establish a file folder for each machine in the laboratory. This should include:

   - A data card as per the example in Figure III-8
   - Manufacturer's information
   - Parts list and supplier's names (identify parts on hand and their location)
   - Maintenance (preventative and special) record

3. Develop a systematic facility shut-down procedure for the summer and startup procedure for the fall, e.g.,
   - Waxing machined surfaces to prevent rusting
   - Greasing and oiling machines
   - Releasing belt-drive tensions
   - Recharging fire extinguishers
   - Sharpening tools

4. Purchase maintenance contracts on large and complex technological equipment if, and only if, it is cost-effective. Otherwise negotiate an agreement with your administration to establish a self-insurance program whereby special maintenance costs do not come out of the ITE budget. Point out the liability incurred by school systems when students work on equipment not in proper condition.

5. Establish a portable maintenance tool box and supply kit that can be quickly picked up and carried to where maintenance is required. This kit should be self-contained and include:

   - A complement of wrenches
   - Punches and chisels
   - Pliers and vise grips
   - Screwdriver set
   - A sample of greases, oils and lubricants and applicators
   - A portable drill and bits, extension cord
   - Hard and soft-faced hammers
   - A volt/amp meter
   - A lock to lock out power and supply switches
   - A set of hang tags to indicate problems/maintenance

6. Use hang tags to indicate machines with problems, e.g.:

   - Do not use
   - Under maintenance
   - Secure instructor permission before operating

7. Incorporate routine maintenance and inspections into the period, daily or weekly clean-up responsibility list.

8. Develop an equipment problem report form and show students how to use it.

9. Annually review the maintenance records to identify growing problems and develop replacement recommendations accordingly.

10. Prepare an annual maintenance report, listing time spent, cost, and activity during the year and submit it to the school administration.

11. Develop a collection of maintenance books and articles.

6. Implementing A Safety Program[1]

Introduction

Safety must be an ever present concern of all ITE instructors. Given the hundreds of thousands of student who over the years have experienced ITE, it is clear that this concern for safety has been attended to. However safety is something that can never be taken for granted. This section presents some guidelines and recommendations that will help ITE instructors in maintaining and increasing safety of their learning experiences.

Wherever one deals with safety, the overall safety hierarchy must be kept in mind. In the business and industrial world this means that a situation is first engineered for safety; then remaining hazards are guarded against; education to prevent and avoid accidents is subsequently provided; and finally personal protective equipment is supplied to further reduce vulnerability. Administrators and instructors are well advised to emulate this private sector practice by:

- specifying and securing only thoughtfully engineered safe machines, equipment and facilities.
- carefully guarding against existing hazards with systematically engineered devices.
- incorporating a comprehensive safety instructional program into the overall course of study.
- providing and requiring the use of necessary personal protective equipment, of appropriate design and quality, in sufficient quantity.

However, any section as short as this one can not adequately cover the complex topic of safety. For details readers are encouraged to consult the resources provided in Part 8 of this chapter. In particular, the Missouri Vocational Safety Guide should be on every ITE professional's shelf. Additionally, instructors are encouraged to consult experts because safety is just too important a concern to be handled individually. The following personnel can provide additional detailed information:

- Missouri's State Industrial Arts Supervisor -- This person, because of his day-to-day involvement, can provide valuable advice on many safety-related matters.
- Specialized Resource Personnel -- These are individuals who are teaching or otherwise specifically concerned with safety. Examples include: university, junior/community college and area vocational school faculty as well as representatives from agencies such as those listed in the Missouri Vocational Safety Guide's "Useful Information" section.
- Industrial Consultants -- Many industries already provide representatives to serve on advisory committees. These and other companies can often supply safety, facility, equipment and material advice.

It is suggested that instructors begin work on safety with a thorough review of what they are currently doing. The Missouri ITE Standards' Topic 9, found in Chapter VIII's part 3, provides the most useful way of accomplishing this. They will guide a systematic review of the:

- ITE Program
- Physical Environment
- Records

---

[1] Much of the material in this section was extracted and/or adapted from Missouri's Vocational Safety Guide, Dyrenfurth & Linhart, 1981.

Then, for additional detail, Missouri's Vocational Safety Guide provides answers to many of the questions instructors will ask. This guide was based on a careful needs assessment of Missouri's educators. For example, the following questions can be answered by using the document:

1. What Missouri Laws govern vocational education (and ITE) safety?
    - Chapter I's "Missouri Specifics" section highlights these.
2. Who has what responsibilities in providing for the safety of students?
    - Chapter II outlines a slate of responsibilities that good practice would seem to suggest. Few can be handled at only one level or position. All together however they mesh to generate the comprehensive blanket of safety concern that educators would want to provide their students.
3. What is my liability potential? Can I be sued?
    - Chapter III attempts to address this most difficult question. Although only the courts will decide cases that reach litigation, this chapter provides an interpretation of precedents and reasoned opinion. Note that the chapter does not substitute for specific legal counsel.
4. How can I protect my students (and myself) best?
    - Chapter IV contains safety program recommendations directed mainly at teachers concerned with establishing a comprehensive safety program that minimizes risk to students and liability potential to instructors and schools.
5. What safety guidelines apply to vocational (and ITE) laboratories and their equipment?
    - Chapter V outlines classroom, laboratory, environmental and machine safety measures that combine with the planning suggested in Chapter IV to provide for a maximum of student safety.
6. What protective devices should students use?
    - Chapter VI describes essential personal protective equipment and its suggested use and maintenance.
7. But how can I provide for the safety of special needs pupils?
    - Chapter VII begins to address this most challenging topic. It begins with the premise that a comprehensive safety program is already in place and that hence only the consequence of a pupil's special handicapping conditions will now need to be addressed.
8. OK, but I've looked it all over and I still need/want more information -- where do I go for additional help?
    - Chapter VIII provides referenced sources, a list of additional sources deemed to be helpful and also a list of national and Missouri agencies that can provide appropriate assistance.

Instruction

ITE instructors must recognize their responsibilities for the safety of their students. Because students are usually minors, and because in all cases, they must be presumed to have incomplete mastery of the skill, knowledge and attitudes associated with the subject being pursued, their instructors must provide for the careful development of those competencies necessary to operate safely in the laboratory, shop, or on the training site. This means that instructors must provide safety instruction. Furthermore, this instruction must be systematic (thorough coverage), performance based (provide clear evidence of accomplishment), reinforced periodically (involve repetition to counter forgetting) and it certainly must be documented (recorded on paper for others to review).

Content and Organization. The safety instructional program employed by instructors should be based on an analysis of known safety hazards, activity requirements, standard precautions, and the like. To identify the content that must form the core of a safety program, instructors must access a large number of safety standards specific to their subject area. Careful selection is necessary to achieve student mastery of three vital objectives:

- To recognize existing and potential hazards
- To understand appropriate defense/avoidance and/or prevention strategies
- To be able to act in time

In all cases, instructors are faced with the decision as to what content to build into the safety instruction. Another important point is to identify which safety instruction should precede all other work and which will be infused throughout the day-to-day instructional activity. It is recommended that instructors approach these decisions by identifying the prerequisite knowledges, skills and attitudes that are necessary to the safe functioning of students during their early learning activities. These need to be mastered before any laboratory experience begins.

Following this, the safety knowledges, attitudes and skills that are needed for subsequent activities must be built into the regular day-to-day instruction. In this way, students are not presented with an artificial dichotomy between "work" and "safety."

The safety program's instructional content needs to be carefully documented, both for purposes of effective initial organization as well as for the record. Both protect the instructor in the event of liability claims. Because it should be readily identifiable as a freestanding component of any course, the safety program needs to be developed with its own goals and objectives, its units of instruction, and of course, its own lesson plans. Although instructors are encouraged to infuse as much safety instruction as possible into their "regular" instruction, in order to insure thorough treatment, it is recommended that they:

- Identify the safety content (knowledges needed, desirable attitudes, required skills) necessary to operate safely in the area being taught.

- Write the goals and objectives for the safety program.

- Organize the safety content into units of instruction.

- Detail each unit of instruction by identifying lesson plans to be taught in each unit.

Suggested Instructional Techniques. Safety instruction is more effective when a variety of approaches are employed and when it is tailored to the objectives being addressed. A comprehensive safety program provides for performance and attitudes in addition to knowledge. Therefore, the methods used must be selected appropriately. Furthermore, instructors are invariably faced with the task of not only teaching the necessary content once, but also of:

- Providing remedial safety instruction when students are not able to demonstrate the desired behavior after initial instruction.

- Providing back-up instruction to those students who were not in attendance during the original instruction.

- Providing reinforcement instruction to bring students back up to a level of performance previously attained but now forgotten.

A review of most available state safety guides has resulted in a list of recommended instructional methods. These include:

- Teach accident prevention with a positive approach -- stressing the right way to perform an operation.
- Give demonstrations emphasizing the safe use of hazardous tools, utensils, machines, equipment and materials.
- Provide instruction on what to do in case of an accident in the laboratory.
- Give periodic demonstrations on the proper use and care of personal protective devices.
- Provide each student with the general safety rules of the laboratory.
- Use a bulletin board for safety bulletins, safety poster and safety rules and regulations. Change eye-catching features regularly.
- Periodically use discussion time to emphasize the importance of student attitude in accident prevention.
- Send letters to parents when a student has exhibited a great degree of interest in safety or when he/she has successfully applied safety practices.
- Require all beginning students to make a careful study to identify possible hazards in the laboratory during the first few days of the course.
- Prepare a written safety education program for the ITE program and each course.
- Provide students with convenient ways to refresh their memory of correct and safe procedures for each assigned activity.
- Provide work station "prompts," labels and signs to alert students to appropriate procedures, guards and personal protective equipment.
- Foster student leadership through a student personnel system for accident prevention.

Evaluation

Teaching safety is a very complex and difficult task. It involves the psychomotor, cognitive and affective domains of student behavior in situations where it is sometimes difficult to measure/monitor progress. Also, because each student is an individual, evaluations should be designed to test students in a variety of ways. Regardless of design, safety evaluations must reflect the material and objectives presented in the instruction and then the results should be carefully recorded.

Obviously a wide variety of techniques can be used to test safety knowledges, attitudes and skills. However, because of legal and moral issues, it is vitally important that they be valid and reliable--otherwise instructors will find they are of no value to them or their students. Some of the more commonly used tests types are:

- Pencil and paper -- a written exam which may be administered at varying intervals after instruction. This could be an examination on general safety rules or on specific safety rules for machines or equipment.

- Observation of performance -- using a checklist of safety rules/procedures to note whether, or to what extent, students use specific machines and/or equipment according to the manner that was demonstrated and taught.

- Critical incident technique -- An observation technique that has instructors identifying attitudes and/or practices that students should demonstrate. Instructors then specify a series of descriptions (critical incidents) that exemplify the varying degrees to which a student can demonstrate the desired behavior. Rating students then involves observations for a period of time and then recording which of the "critical incidents" were noted thereby indicating the extent to which the student has demonstrated the desired behavior. Figure III-15 provides a sample of a critical incident rating scale from the Vocational Safety Guide.

Figure III-15

Sample Critical Incident Technique Safety Rating Format

Safety Area Being Rated	**Low Safety Concern**			**High Safety Concern**
Housekeeping	Leaves tools and equipment in work area, does not clean work area before or after working	Replaces tools. Begins and finishes work without cleaning up his/her work area	Cleans up area after job is completed, but is less concerned with problems outside his/her work area	Observes various safety hazards and works to correct even if outside of his/her direct work area
Personal Protective Equipment	Has to be reminded to wear safety glasses, aprons, proper shoes, etc., several times during the class.	Occasionally fails to use required protective equipment for the job being performed.	Always uses PP-equipment, usually attempts to clean equipment before or after use. protective	Uses protective equipment for each job performed. Performs daily maintenance on equipment. Cleans equipment before and after use.
Machines and Equipment	Attempts to adjust machine while it is running. Does not use proper guards and procedure.	Occasionally fails to following operating instructions for machine. Does not think through operations.	Insures guards are in place while operation equipment. Reads and follows operating instructions.	Follows safety rules and regulations. Cares for the safety of others while in his/her work area. Informs instructor of safety hazards.
• • •				

Record Keeping

It is absolutely essential for instructors to keep safety-related records. One main objective for this is to call attention to accident prone areas/processes so that steps may be taken to correct an unsafe condition. Records may also be used to protect an employee (instructor) and/or the employer (administrator and board) if either is required to provide evidence of instruction or use of proper safety procedures. Additionally such records assist instructors in tracking student progress and subsequently in tailoring instruction to meet individual needs.

Among the recommended record keeping procedures are:

- Require each student to sign information sheets dealing with laboratory safety rules and regulations to indicate that he/she has read and understood the regulation. A copy of the information sheets should be kept on file and students should keep the original along with relevant instructional material.
- Require students to demonstrate appropriate levels of proficiency on safety tests before using equipment. Subsequently, students should have to sign their names on each test and thereby indicate that they have received instructions and passed the safety examination.
- Retain all safety information sheets and tests in student files in instructor's office.
- Prepare a classroom chart to indicate safety instruction given, date of instruction, student attendance and safety test performance.
- Prepare and file an appropriate accident report form for each injury requiring treatment.
- Keep records of instruction given, attendance of students, student performance tests, safety evaluative tests, maintenance of equipment, memos and letters concerning safety practices (Texas Industrial Technology Curriculum Guide, p. 291).
- Notations citing date, time and circumstances should be made of chronic disruptive behavior and violations of safety procedures. These notations should be placed in each student's cumulative folder, reviewed regularly with the student and, where necessary, referred to administration for appropriate action (Texas Industrial Technology Curriculum Guide, p. 291).
- Keep records for a period of time as advised by school counsel.

Accident Reports

Accident reports are an essential part of a good safety program. They help to inform, educate and remind people of what to look for in regard to accident prevention. They also provide an important record of safety infractions and safety precautions. The following procedure is one that could be employed. (Vocational Safety Guide, 1981, p. 40)

1. Fill out the accident report form within 24 hours of the incident. This guards against details that may become vague after a few hours have passed and that may thereby affect the report's accuracy.
2. Prepare your report in duplicate. One should be hand-delivered to the principal (or supervisor) and another should be kept in your personal files.
3. Include information on the basis of how, where, what, who, when and why the accident happened in reconstructing the sequence of events.

4. The U.S. Department of Labor has recommended that the following principles should be observed in preparing reports...

   a. Use common sense -- Stick to the facts, weigh their value, reach justified conclusions.

   b. Investigate each clue -- Apparently reasonable conclusions will often be changed by exploring factors which initially may not appear to be important.

   c. Check for unsafe conditions and facts -- Both are present in the great majority of accidents.

   d. Make recommendations - No investigation is complete unless corrective action is suggested and carried out.

   e. Investigate all accidents -- Chance is often the sole difference between a trivial accident and a serious one. Results cannot be predicted.

Figure III-16 presents a Standard Student Accident Report Form developed by the National Safety Council. This form is straight-forward yet it obtains a large amount of data to document an accident effectively. It is also a very efficient method that yields data for the summary report that should be developed at least annually. Such a summary organizes data so that corrective actions can be taken to prevent recurrence of accidents.

Additional information about student accident reporting is available from the National Safety Council. They have made available, to all school districts that enroll 300 students or more, the Student Accident Reporting Guidebook. This guide can be obtained by writing to the National Safety Council, at 425 N. Michigan Avenue, Chicago, IL 60611.

Treatment of Injuries

Typically state and school policy, as well as good practice, call for ITE instructors to avoid supplying or administering medication. In fact, teachers are well-advised to avoid any treatment (other than first aid) of a wound or injury. It is also recommended that each ITE instructor have taken a certified first aid course. To provide for students' safety, be sure to instruct them to report all injuries -- no matter how small -- to the instructor and the school nurse!

Inspections

A safe environment is an essential part of a safety program. A safe environment will exist only if hazards are discovered and corrected through regular and frequent inspections by school personnel-administrators, safety coordinators, insurance and fire personnel, teachers and students, state supervisors, university faculty, and service area specialists. It is recommended that the ITE standards, provided in Chapter VIII's part 3, be used to guide such inspections. Depending upon the type of shop/laboratory or circumstances involved in each case, safety inspections by several persons might be necessary. The ITE teacher should also be making a constant safety inspection as he/she goes through daily routines -- always alert to changing conditions or work methods. In most cases, teachers need to make hourly checks and inspections to be certain that all safety precautions are in place.

A safety inspection/checklist is an objective tool to help improve working and learning conditions in the laboratory. Using a detailed safety checklist, such as the one developed by the National Safety Council and which is provided in Missouri's Vocational Safety Guide (1981), for the inspection has some advantages over other methods. A sample page is provided in Figure III-17. Such checklists serve several purposes in that they:

- inform, educate and remind persons of key characteristics of safe environments.

- train personnel to be sensitively observant and aware of their environment.
- provide a source of feedback to teachers and administrators that indicates the extent to which the ITE facility is a safe environment.
- provide a record of safety items and prevention activity.

Figure III-16

Student Accident Report Form[1]

STUDENT ACCIDENT REPORT

____ School Jurisdictional ____ Recordable
____ Non-School Jurisdictional ____ Reportable Only

School District: ____________________

City, State: ____________________

1. Name: ____________ 2. Address: ____________
3. School: ____________ 4. Sex: ______ 5. Age: ______ 6. Grade: ______
7. Time Accident Occurred: ______ Day of Week: ______ Time: ______ a.m. p.m.
8. Nature of Injury: ____________________
9. Part of Body Injured: ____________________
10. Degree of Injury: Death: ____ Permanent: ____ Temporary: ____ Non-Disabling (no lost time): ____
11. Days Lost: From School: ____ Activities Other Than School: ____ Total: ____
12. Cause of Injury: ____________________
13. Accident Jurisdiction
    ____ School ____ Grounds ____ Building ____ To and From: ____
    ____ Non-School ____ Home ____ Other: ______ ____ Activities not on School Property
14. Location of Accident (Be specific): ____________ 15. Activity of Person: ____________
16. Status of Activity: ____________ 17. Supervision (if yes give name & title): ____________
18. Agency Involved: ____________ 19. Unsafe Act: ____________
20. Unsafe Mechanical/Physical Condition: ______ 21. Unsafe Personal Factor: ____________
22. Corrective Action Taken or Recommended: ____________________
23. Property Damage: School $______ Non-School $______ Total $______
24. Description (give a word picture of the accident, explaining who, what, when, why and how)
25. Date of Report: ____________
26. Report Prepared by (signature & title): ____________ 27. Principal's Signature: ____________

---

[1] Adapted from the National Safety Council's 1966 recommendations.

Figure III-17

Safety Inspection Checklist (Sample Page)

National Standard School Shop Safety Inspection Checklist[1]

Introduction

A safe environment is an essential part of the school shop safety education program. The safe environment will exist only if hazards are discovered and corrected through regular and frequent inspections by school personnel--administrators, teachers and students. Safety inspections are to determine if everything is satisfactory. Inspections may be made at the request of the board of education, the school administration or upon the initiative of the teacher. Some communities have drawn upon the cooperative service of professional safety engineers, inspectors of state labor departments, insurance companies and local safety councils to supplement and confirm inspections by school personnel. The National Standard School Shop Safety Inspection Checklist, recommended by the President's Conference on Industrial safety, is an objective inspection procedure for the school shop.

Directions

Who Inspects? This will depend upon local policies. It is recommended, however, that shop teachers and students--the student safety engineer and or student safety committee-participate in making regular inspections. This not only tends to share responsibility but stimulates a broader interest in the maintenance of a safe school shop.

When to Inspect? As a minimum a safety inspections should be made at the beginning of every school term or semester. More frequent inspections may be advisable.

How to Inspect? Inspections should be well planned in advance. Inspections should be systematic and thorough. No location that may contain a hazard should be overlooked. Inspection reports should be clear and concise, but with sufficient explanation to make each recommendation for improvement understandable.

Follow-up The current report should be compared with previous records to determine progress. The report should be studied in terms of the accident situation so that special attention can be given to those conditions and locations which are accident producers. Each unsafe condition should be corrected as soon as possible in accordance with accepted local procedures. A definite policy should be established in regard to taking materials and equipment out of service because of unsafe conditions. The inspections report can be used to advantage as the subject for staff and class discussion.

Checking Procedure

Draw a circle around the appropriate letter, using the follow letter scheme: S--Satisfactory (needs no attention); A--Acceptable (needs some attention); U--Unsatisfactory (needs immediate attention).

Recommendations should be made in all cases where a "U" is circled. Space is provided at the end of the form for such comments. Designate the items covered by the recommendations, using the code number applicable. In most categories, space is provided for listing of standards, requirements or regulations which have local applicability only.

A. GENERAL PHYSICAL CONDITION

1. Machines, benches, and other equipment are arranged to conform to good safety practices. ...S A U
2. Condition of stairways ....S A U
3. Condition of aisles ....S A U
4. Condition of floors ....S A U
5. Condition of walls, windows, and ceilings ....S A U

---

[1] Prepared by the Joint Committee of the American Vocational Association -- National Safety Council.

Organization and Approval of the Overall Safety Program

Several points are essential to a carefully organized and properly endorsed safety program. Most importantly, such a program will exist both on paper and in practice. In other words, a safety program will not exist merely on paper as a compliance document, **but it will occur in the day-to-day practice of the program** (Vocational Safety Guide, 1981, p. 54). A complete safety program will include a wide variety of components:

1. A statement of the educational system's general policy for the safe operation of ITE courses.
2. A statement of objectives for ITE's overall safety program.
3. A content outline of the safety information to be incorporated in each course.
4. An outline of the methods used to provide safety education to students.
5. A description of the methods and instruments to be used to assess student knowledge and skills as they relate to safety.
6. Separate and specific statements of practices and precautions required for safe operation within each individual course.
7. A plan for the periodic inspections and maintenance of facilities, materials, tools, machines, equipment and personal protective devices (as appropriate) used to provide instruction.
8. A staged (time-lined) plan for the eliminations of all known hazards and problems.
9. Specifications of the emergency procedures to be followed in the event of an accident/injury involving a student, teacher or other individual for each separate ITE facility.
10. A description of the record keeping practices to be employed in documenting safety instruction, attendance and control of class movements and of accidents/injuries that occur.
11. A plan for the ongoing in-service training of instructors in safety-related content, skills and procedures.

Format. It is recommended that each system and/or program organize their safety programs in a loose-leaf format with tab dividers to reflect each major section as outlined above. Furthermore it would be advantageous to provide each instructor with copies of the general sections as well as of the sections that pertain specifically to his/her own service area (and courses). In addition, it will be important that one complete manual be available in each building. (Vocational Safety Guide, p. 56)

Approval Procedures. Ultimately, the most significant safety program approval that can exist is that from the Board of Education that governs the system/institution involved. Consequently, it is recommended that each board consider itself responsible to review and formally approve a carefully developed, systematic, system-wide safety program. Because boards have a reasonable right to expect that materials presented to them are appropriate and thorough in their content, it is recommended that instructors follow the approval sequence as shown (Vocational Safety Guide):

1. Conduct a local instructor and supervisor workshop to orient staff to that which is needed, to assign development responsibility and to establish time lines.
2. Hold meetings to consolidate the specifics of the safety program and to coordinate treatment of safety items in each course.
3. Request input and revision from the state industrial arts supervisor and from program advisory councils.

4. For larger systems, hold a system-wide meeting of faculty to coordinate safety programs across the board.

5. Prepare a brief outline of the steps used to develop the system's safety program. Then, together with a cover letter from the system's chief ITE administrator, route the complete program outline and cover letter through the superintendent, to the president/chairperson of the Board of Education and request formal approval.

Instructor Liability

The instructor has the legal responsibility for accidents that involve students while they are participating in activities to which they have been assigned. Instructors may be held liable for accidents that happen as a result of their negligence and this liability may also extend to administrators. The prevention of, or protection from, liability may be best accomplished by strictly following this checklist:

1. Obtain adequate liability insurance from the International Technology Education Association, the American Vocational Association, the education association in your state, or other appropriate sources.
2. Provide adequate supervision, and be in the classroom or laboratory at all times when class is in session. Never leave while any student is in the laboratory.
3. Act as a reasonable and prudent person would act under the same or similar circumstances.
4. Correct known dangerous and defective conditions or report them to the proper authority, and clearly mark them out of order or dangerous.
5. Use good sense in the selection of student activities.
6. Insist that safety glasses be worn in all areas in which there is equipment and even a remote chance of eye injury.
7. Provide proper instruction in the use of all tools, machines and equipment.
8. Implement a comprehensive safety program and rigidly enforce all rules and regulations.
9. Maintain the entire physical facility in safe working condition.
10. Provide proper protective equipment and require students to wear it and proper clothing while working in the laboratory.
11. Clearly label all toxic and flammable materials and provide proper storage for them.
12. Insist that industrial quality guards be provided and used whenever a machine is operated.
13. Set a proper example for students to follow.
14. Know your students!

7. Informing Key Constituents (Public Relations)

Often the informing of key constituents (public relations) is considered something that is of secondary importance -- but never by successful teachers and administrators. There are several excellent guides to effective public relations, among them Promoting Vocational Education: A Public Relations Handbook for Vocational Educators. The reader is encouraged to review this guide for additional detail. Similarly the Missouri ITE Standard's Topic 8 (in Chapter VIII's part 3) provides a useful start.

A comprehensive public relations program begins with a systematic plan. ITE instructors are encouraged to employ the following steps (adapted from Promoting Vocational Education, p. 13) in developing their public relations program:

1. Identify your internal and external publics. Think in terms of the influential individuals and groups in your community and institution such as those listed in Figure III-18's first column.

2. Collect data on your publics. Find out what your publics know and think about your programs, and what they want and need to know. Do your homework carefully -- there is no point in spending time and energy to launch a public relations campaign without first knowing what change you should try to bring about.

3. Identify the problem areas. As you assess the views of your publics, certain problems and issues will begin to emerge.

4. Establish short- and long-term objectives. Be realistic about what can be accomplished.

5. Determine your public relations details, organization and strategy. Select the communication techniques and media for accomplishing each objective. You will have to consider your budget in making plans, but don't feel that the job is hopeless if your budget is small or nonexistent; ask for volunteer help and keep an eye out for shortcuts and low-cost techniques. Some items to consider in a plan include:

   - School or program or AIASA newsletter
   - Annual or more frequent open houses
   - Slide shows
   - Presentations to civic groups
   - Displays and exhibitions
   - Contacts with local technical groups
   - Local, state and national competitions such as the annual Missouri Industrial Technology Awards Program
   - Technology festival
   - News & media releases
   - A program advisory council
   - Interface to the PTA
   - Student organization activity
   - Newspaper articles

6. Map out your program. Schedule your activities in chart or calendar form. Time activities so you reach your publics frequently.

7. Implement your program. This is the most time-consuming and difficult part of the process! Monitor your expenses in time and money as you go along, and reallocate your resources as necessary.

8. Evaluate your program. At least once a year, study the effectiveness of your efforts. Figure III-18's matrix provides a framework useful for such an assessment. Use your findings to make adjustments in future planning.

Figure III-18

Public Relations Analysis Matrix[1]

Target Groups	Objective	Achievement Review						
		EVALUATION						COMMENTS
		Difficulty			Achievement			
List each specific target group important to your program's public relations	List specific objectives for each target group. Specify date and outcome measures.	Difficult	Average	Easy	Completely	Partially	No Progress	Update objectives and activities here
Internal								
Administrative Staff								
Advisory Committees								
Federal/State Agencies								
Guidance Personnel								
Other Teachers								
School Board Members								
Students								
Student Organizations								
Support Staff								
External								
Business & Trade Associations								
Civic Groups								
General Public								
Employers								
Legislators								
Labor Organizations								
Mass Media								
Parents								
Other:________________								
________________								

INSTRUCTIONS:

Enter the objectives and dates for each specific target group. Also rate the difficulty of each objective/group combination. Then, at the end of the year, rate the extent to which you have achieves each objective. At that time also develop a new plan for the following year. (Adapted from Promoting Vocational Education..., p. 17).

---

[1] Adapted from Promoting Vocational Education, 1978, p. 17.

8. Resources

________. A Guide to Planning of Industrial Arts Facilities. 24th Yearbook. Washington, DC: American Council for Industrial Arts Teacher Education, 1975.

________. Developing Shop Safety Skills. Student & instructor guide and slide/tape. Athens, GA: American Association for Vocational Instructional Materials, n.d. [VE-903-S, SW, I, AV].

________. Industrial Technology Curriculum Guide. Austin, TX: Texas Industrial Arts Association, n.d.

________. Iowa Industrial Arts Handbook for Selected Aspects of Organization and Administration. Des Moines, IA: Iowa Department of Public Instruction, n.d.

________. Planning and Equipping Industrial Arts Instructional Facilities. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, revised ed., 1976, [IA-1-1].

________. Power Tool Safety and Operation. Student and teacher manual c/w examinations and transparency masters. MN: Hobar, n.d., [VE 273 H-I, VE 173 H-S].

________. Promoting Vocational Education: A Public Relations Handbook for Vocational Educators. Washington, DC: American Vocational Association, 1978.

________. Safety Color Coding for the Shop. Student guide and slide/tape. Athens, GA: American Association for Vocational Instructional Materials, n.d., [VE-904-S, AV].

________. Safety Exams. Complete set of 24. MN: Hobar, n.d., [VE-625H-H].

________. Student Accident Reporting Guidebook. Chicago, IL: National Safety Council, 1966.

Barnes, James L. Systems of Technology: Organization and Management of Instruction Handbook. Austin, TX: University of Texas-Austin, Center for Occupational Curriculum Development, 1984.

Bender, Myron. Educational Specifications for Industrial Arts Education Instructional Facilities. Bismarck, ND: The North Dakota State Board for Vocational Education, 1978.

Brown, Robert D. Industrial Education Facilities. Boston, MA: Allyn & Bacon, 1979.

Darrow, Don & Pine, Douglas. Iowa Industrial Arts Handbook. Des Moines, IA: Iowa Department of Public Instruction, 1980.

Dillenbeck, Fred. "Knocking down the walls to set up for Tech-Ed." School Shop, April 1986, pp. 45-47.

Dugger, Jr., William. et al. Standards for Industrial Arts Programs. Blacksburg, VA: Virginia Polytechnic Institute and State University, 1981.

Dyrenfurth, Michael J. & Linhart, Richard E. Vocational Safety Guide. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, 1981.

Iley, John. "Technology Programs: Pittsburg, Kansas." The Technology Teacher. February 1987, pp. 23-30.

Irvin, David. Power Tool Maintenance. New York: McGraw-Hill, 1971.

Prakken, Lawrence, W. (Ed.). Modern School Shop Planning. Ann Arbor, MI: Prakken Publications, Inc., 7th edition, 1978.

Stallsmith, Douglas D. Guidelines for Planning Industrial Education Facilities and Equipment. Bulletin No. 9176. Madison, WI: Wisconsin Department of Public Instruction, 1977.

Strong, Merle. (Ed.). Accident Prevention Manual for Training Programs. Illinois: American Technical Society, 1975.

Towler, Alan. The Industrial Arts Guide. Austin, TX: Center for Occupational Curriculum Development, The University of Texas-Austin, n.d.

Windham, Billy L. "A Planning Guide for Texas Technology Education." Presentation delivered at the International Technology Education Association's Annual Conference, Tulsa, Oklahoma, March 1987.

Chapter IV

TEACHING INDUSTRIAL TECHNOLOGY EDUCATION[1]

1. Introduction

As most educators know, the principal facilitator of student learning is the classroom teacher. If they are successful in establishing an atmosphere of mutual respect and if they genuinely care for their students' welfare much learning will take place. Part of this atmosphere comes from how classes are taught, some from the materials and methods used, some from the accommodation of individual differences, and some from the provision of equitable instruction for all.

Part 2 of this chapter addresses the planning of instruction. It also lists the types of materials that are helpful in teaching. These materials are listed here to promote their inclusion during the planning process.

Part 3 addresses the topic of selecting instructional methods. Several methods, some new and innovative and some well-proven, are listed with descriptions of how they may be used. Short descriptions of selected techniques are also included to provide a common starting point for teachers in their curriculum planning process.

Part 4 deals with issues involved in meeting the individual needs of students. These individual needs range from different learning modes to provisions for various learning disabilities. This section also lists and describes the various classifications of special needs students. The intent is to inform ITE instructors of common traits of typical disabilities in order to better enable them to recognize, obtain assistance for, and service handicapped and disadvantaged individuals.

Closely related to the topic of special needs is the moral and legal requirement to provide equitable educational experiences for all groups. In this chapter's part 5, the topic of equity for all groups, whether based on sex, race or minority, is addressed.

Also included in this chapter, in part 6, is the topic of student organization activities. The purposes and goals of the Missouri Industrial Technology Education Student Association are listed. It is emphasized that many of this group's activities should be co-curricular, involving other educational areas such as mathematics, history, or English as they reinforce the ITE curriculum.

The final part of this chapter, part 7, deals with teaching basic employability skills. These skills, the actual foundation of general working and vocational competence, are those required for successful job seeking and retention and they represent a significant affective, pre-vocational outcome from participation in our curriculum.

Then, following this guide's established pattern, part 8 lists selected resources teachers can turn to for additional help on any of this chapter's main topics.

---

[1] The MOITE Guide development team appreciates the work of Mr. David Baird in developing this chapter.

Notes:

2. Planning Instruction

Planning instruction for an Industrial Technology Education program should be no different from the processes used for any other classroom/laboratory course. Theory and common sense indicate that a variety of methods must be used in order to provide the widest range of learning opportunities for students with diverse learning styles. By thoroughly planning for educational experiences, consideration can be given to students who are visual learners, auditory learners and those who prefer learning through kinesthetic (hands-on) activity. Lesson objectives must be delineated, lesson plans must be created, activities determined, instructional materials selected and evaluative criteria established with each student's preferred learning modes in mind. All of these components must be developed hierarchically from the overall course goals to the daily lesson objectives.

Chapter II's part 6 describes the documentation needed for appropriate planning and instruction to take place within the ITE classroom/laboratory. Specifically, it describes the contents and functions of courses of study, major units, instructional modules and lesson plans. Essentially Chapter II provided guidelines for planning the curriculum i.e. the "what" (content) to teach. This chapter (IV) focuses on "how" to teach. As such, the following pages detail guidelines to help the teachers decide on teaching methods and materials.

The following is a list of instructional support materials commonly used by industrial technology education programs. Each carries implications for the use of specific instructional strategies. It is apparent from this list that instructional materials are quite diverse and provide a variety of choices for adoption into instructional lessons. ITE instructors are encouraged to use the broadest range possible in order to meet the greatest number of student needs.

- video-tapes
- audio tapes
- computers
- drawings
- films
- information sheets
- instruction sheets
- interactive video
- learning activity packages (LAPS)/self-instructional modules
- models
- photographs
- reference books
- simulators
- slide tapes
- textbooks
- tools and equipment within specific subject area

Figure IV-1's overview of instructional strategies serves to demonstrate the interrelationship between instructional methods and materials. A method of instruction may be selected that suggests the use of several materials appropriate for the technique. Alternatively, a material item that is especially effective may be selected which in turn will dictate one or more methods of instruction. Both approaches are appropriate and should be used in order to create the optimum learning environment.

The planning of instruction or a delivery system must reflect careful consideration of the principles of learning. Although many have outlined these, one of the most understandable sets was delineated by Dr. Blair of the University of Illinois. Figure IV-2 presents these principles and it should prove to be of considerable assistance to ITE instructors as they plan their instruction.

Figure IV-1

Overview of Instructional Strategies[1]

LECTURE

DISCUSSION

LABORATORY

DEMONSTRATION

INDIVIDUAL SMALL GROUP
  3-5 Students

LARGE GROUPS
- Read
- Write
- Illustrate
- Practice
- Observe
- Buzz Sessions
- Brainstorm
- Role Play
- Simulation
- Interview
- Survey
- Student Panel

PRINTED MATERIALS:
- Text and supplementary books
- Manuals and workbooks
- Handouts
- Articles and pamphlets
- Magazines
- Modules
- Programmed Instruction
- Games
- Learning Activity Packages (LAPs)
- Job Sheets
- Information Sheets
- Assignment Sheets
- Tests
- Quizzes
- Posters
- Encyclopedias

PEOPLE AND PLACES OUTSIDE THE CLASSROOM:
- Guest Speakers
- Panel Discussion
- Guest Demonstrators
- Interviews
- Work-Experience

INSTRUCTIONAL TECHNOLOGY:
- Filmstrips
- Computer-assisted learning
- Films
- Sample kits
- Films
- Television
- Video-Tapes/Recording
- Slides
- Slide/Tape Shows
- Audio Cassettes
- Photographs
- Opaque Projector
- Filmloops
- Overhead projection in transparencies
- Models

Select or combine resources, methods, and activities to design LEARNING ACTIVITIES

---

[1] Based on Introduction to Vocational Education Instructional Management, 1984.

Figure IV-2

Blair's Principles of Learning[1]

1. We learn to do by doing.
2. We learn to do what we do (and not something else)
3. Without a sufficient stage of readiness, learning is inefficient and may even be harmful.
4. Without motivation there can be no learning at all.
5. For effective learning, responses must be immediately reinforced.
6. Meaningful responses are better learned and retained longer than less meaningful ones.
7. For the greatest amount of transfer learning, responses should be learned in the way they are going to be used.
8. An individual's responses will vary according to how he/she perceives the stimulus (situation).
9. An individual's responses will vary according to the classroom atmosphere.
10. Every person always does the only thing he/she can possibly do considering their physical inheritance, background of learning and the forces that are acting upon them.

---

[1] Dr. Glen Blair, University of Illinois-Urbana.

A Sampling of Methods

Field trips. Utilize field trips for more than observation of industrial processes. Use discussion and oral or written reports on the various occupations involved in the process observed. Bring back the industry or technology with modern communications technology, e.g., video-tape.

Guest speakers. Have one or more speakers address the class about past or present occupations and the training and skills required to function in them. Have them bring out the rapidity of technological change and highlight emerging technology.

Student personnel system. When setting up the organizational chart, try to emulate industrial organization and procedure. Provide specific information on the occupations involved.

Interviews. Require students to interview people involved in various occupations. Have them make written or oral reports to the class. Provide guidelines for the format of interviews. Include questions about how one best prepares for such employment.

Bulletin board. The bulletin board can be an effective teaching method if used properly. Place items on the board that will stimulate interest and questions, something that will make them want to find out more, then provide students with a way to do so. Change your display often!

Class discussion. Class discussions can be interesting and involving for students -- if they are carried out in a non-judgmental manner. Listen to what students have to say and try not to dominate the discussion. Set up situations causing students to associate and make applications of the information presented.

Role playing. By means of simulated technological/industrial activity, role playing affords students the opportunity to identify with typical life activities as they exist in various occupations and/or professions. Through role playing, students can experience some of the reality of work responsibilities. It is especially well-suited for use with enterprise laboratory activities, mass production activities, research and experimentation and group project experiences.

Group project. The group project method involves the designing, planning and development of a product by a group of students. It differs from the mass production method in that only one (or a few) finished product(s) results from the activity of the group. Ideally, the project selected has numerous elements thus permitting the effective use of committees or other sub-groups. The method has been used successfully at the junior high level for studying high volume production industries such as paper and paper products, oil, iron, glass and rubber. At the senior high level, the group project might take the form of designing and constructing a machine, vehicle prototype or other large project.

Conceptual learning. Current educational theory emphasizes the need to develop fundamental concepts and skills which have functional value in a wide variety of applications. This learning generally is referred to as conceptual learning. For example, the concept of molding enables the student to relate general knowledge and skills to many specific types of industrial processes such as forging, foundry and casting and in several material realms, e.g. metals, ceramics and plastics. A study of general or fundamental principles insures that loss of specific details will not mean a total loss. The remaining understanding will permit reconstruction of details when necessary. This approach is based on the notion that concepts have greater application to new situations than do specific facts.

Enterprise. The enterprise approach involves a simulation where students assume career roles and solve problems in a manner similar to their counterparts in industry. The enterprise method often involves such activities as research and development, financing, mass production, servicing, communication, transportation, distribution and marketing. At elementary and junior high levels, the emphasis might be directed toward activities of a simplified nature, since only limited time would be allotted for the activity. At the senior high level, activities may be more complex and greater emphasis is placed on tooling and higher technology.

Cooperative work study. Many students enrolled in ITE programs can profit from on-the-job experiences designed to supplement in-school learning. Such experiences assist students in further development of skills and positive attitudes toward work and school. Often they aid them in assessing and establishing career goals and this enhances their potential for successful employment in the future. Other significant out-of-school techniques include industrial observation and community projects. All out-of-school industrial experiences require supervision and evaluation by qualified school personnel to ensure that the experience and environment are adequately serving the student's educational goals and that safety and other safeguards are provided.

Seminar. The seminar method emphasizes student interaction and contribution. It is used to identify individual problems and to provide for group assistance in finding solutions to these problems. The seminar provides a continuing opportunity for student peer evaluations as well as presentation of individual student progress. With the seminar method, the teacher assumes the role of a facilitator, observer, evaluator and advisor. In the seminar students become involved in challenging, questioning, assisting and discussing. The method has been used successfully in combination with the enterprise, group, research and experimentation and other more traditional instructional methodologies.

Individualized instruction. Individualized instruction provides for the varying abilities and interests of students. It involves development of self-instructional units or modules in a manner which enables students to independently: (1) pre-assess their performance and knowledge of the objectives, (2) progress through specified learning activities at their own pace, and (3) assess their own terminal performance and achievement of unit objectives. A variety of hardware and software systems have been developed to facilitate management of the instructional approach. These include auto-tutorial systems, tape-slide, tape-filmstrip, programmed references, student contracts, learning activity packages, educational games, and computer assisted instruction. All have great potential for helping students learn and consequently their use is strongly encouraged.

A delightful source on useful teacher hints that can effectively guide the instructor as he/she plans their teaching methods is found in Tischler's pamphlet entitled Thoughts on Learning . . . . He has assembled a set of valuable insights but then he has moved beyond mere summary by highlighting their implications for teachers. Figure IV-3 presents a sample selection of these.

Figure IV-3

Tischler's Thoughts on Learning[1]

PRINCIPLE:

The whole does not necessarily equal the sum of the parts. Example: *You can teach a student all about nails, screws, lumber, windows, doors and paints and he /she still cannot build a house (a system).*

APPLICATION:

Any subject to be taught is like fitting together the pieces of a puzzle. Organize your materials so that the student first sees only the system without the details. Details often require specific skill development or prerequisites neither of which the beginner may have. Later relate each detail to its place in the system.

PRINCIPLE:

The teacher is like a person standing on a cliff watching a canoer navigate a turbulent twisting river. From the teacher's vantage point, he/she sees the whole (the overall concept) of the problem. The student, like the canoer, experiences one surprise after another. Each turn is a new challenge. Each moment is loaded with anxiety and surprise. Oh, for the student to have the vantage point of the teacher.

APPLICATION:

Before starting a curriculum, a course, or a lesson, develop the concept theme. Arrange your activities so that the student is standing on the hill looking at the overall subject matter before starting into the details. Then, from the student's vantage point he/she should be better able to determine his/her future plan of action or reaction.

---

[1] Tischler, Thoughts on Learning, n.d.

Figure IV-3, Continued

Tischler's Thoughts on Learning

PRINCIPLE:

When one approaches learning as an opportunity to "discover something" rather than the task to "learn about something," the feeling of self-reward takes over, thus causing a greater interest and in-depth investigation.

APPLICATION:

The teacher should organize his/her subject to excite the student toward the thrill of discovering some new thought or idea. The student will thus be motivated to learn. Discovery through learning causes a behavioral change. Repeating of facts may be dull and not contribute to learning. Discovery may lead to disappointments, but it also may lead to the thrill of greater discoveries.

PRINCIPLE:

Tell the student what and how you are going to teach him/her. Teach the student what you told him/her you were going to teach him/her. Tell the student what you taught him/her.

APPLICATION:

Before teaching subject matter, explain how you have organized your program and what methods of teaching you will be using. You cannot expect the student to learn, when he/she doesn't know how you expect to teach him/her. Then be sure to follow the methods you have outlined, and summarize by telling what you have taught.

PRINCIPLE:

Learning is easier and more effective when the student uses two or more of his/her sensory transducers.

APPLICATION:

For any subject, present your material so that you require the student to use as many of his/her senses as possible. Hearing provides about 15% perception, seeing 60%. Don't stop with these. There is still 25% more reception to tune in on: touch, smell, taste and the emotions.

PRINCIPLE:

For education to be meaningful, it must do something for the student in the present. The future may be too far away to be meaningful.

APPLICATION:

Education must pay off now! The fact that it will be helpful later is nice to know, but if education doesn't pay off in the present -- the same type of education may not apply for the future.

Education must be meaningful -- not a promise. If you teach Algebra I because it is a need for Algebra II then the program is doomed to fail, since it provides no compensation right away; only a promise for a future goal.

Figure IV-3, Continued

Tischler's Thoughts on Learning

PRINCIPLE:

An explanation of subject matter, even today, is composed of a too large a proportion of words and too small a proportion of understanding.

APPLICATION:

Come to class prepared. Know what and how you will present the subject. If you really know this, perhaps it will not take many words. Find better ways to present your subject, by minimizing on words, maximizing understanding.

PRINCIPLE:

Learning starts from an understanding of previous experiences upon which new ideas are built. During the transition ideas are built. During the transition process, material things become less important, and meaningful verbal expression becomes more important.

APPLICATION:

The beginning student needs a variety of activities. The retention span appears short. Use several activities to present the same material. For example: Present the abstract; validate the information by experiment. Then apply the theory, method of relating the experiment, to an actual application. In the laboratory the student tests the teaching, book, film, etc. In the application the teacher should test the student.

PRINCIPLE:

One cannot cover some subjects in full, even in a lifetime, especially if coverage means considering all the facts and their applications. Therefore, be selective and remember that education is cyclical, the student will return again-and-again to the subject at later dates.

APPLICATION:

Remember that your teaching occupies only one segment on the educational yardstick of time. Don't cram too much in at one time. Cover the most meaningful points at this stage of development of the subject. The student will return to the subject later as the spiralling cycle of education continues.

PRINCIPLE:

Learning is not obtained through a single inoculation: Once you've had it, you won't need it again. Booster shots are needed to assure continued proper response by the learning system.

APPLICATION:

Don't expect the student to remember the facts just because you taught them once before. From time to time you must reinforce the information previously taught. Remember the bucket you are filling may have a slow leak. Some leaks may not be so slow.

Figure IV-3, Continued

Tischler's Thoughts on Learning

PRINCIPLE:

Understanding human memory is quite complex. One thing is certain, unless a detail is placed into an organized structure, it is soon forgotten. The organized structure is a SYSTEM.

APPLICATION:

Decisions can be made based on a broad conceptual understanding providing the known facts are all part of a system. Try to build them to an existing system. Children learn by systems from birth. The system of walking, talking, eating and sleeping are all detailed, systematic processes. Without knowing the details the child is able to learn. Teachers, on the other hand, often feel the student won't understand unless he/she is first given all the details.

PRINCIPLE:

The development of a CONCEPT depends upon the study of the relationship between seemingly unrelated facts. The concept grows broader as these relationships come closer together.

APPLICATION:

The learner may not see the relationship between seemingly unrelated facts. The teacher can show how these facts fit together so as to help the learner develop an overall understanding (a concept). The tighter the relationship is brought together the better the understanding of the concept.

3. Selecting Instructional Methods

Success in the classroom depends on many factors. Foremost among these is hard work on the part of the teacher. Educational programs must be adaptable. They must be flexible enough to remain workable in all locales, in many types of facilities, and with students possessing differing values and interests. A successful program must be capable of application in all situations and at all levels.

Industrial Technology Education is concerned with industry, technology, its practices, procedures and products. Within the classroom/ laboratory, student experiences should be tailored to develop understandings, attitudes and skills pertaining to technology rather than to the production of a take-home product (the project). Although a finished product may well be produced by each student, or by a group of students, it is important to remember that the project is not the goal but rather it is a by-product of the process of learning about technology and industry.

Curriculum content is not the only important element in the teaching-learning environment. Because of the differences in pupil learning styles and teacher proficiencies, varied instructional methods must be used and evaluated. Traditionally, many instructional methods have been used in industrial technology education programs. Methods such as lecturing, demonstrating, designing, problem-solving, and constructing individual projects have long been recognized as effective instructional approaches for presenting content. These are being supplemented by emerging instructional methodologies which provide increased potential for developing technological, industrial and career understandings, attitudes and skills.

When developing lesson plans for a program, it is essential to determine which teaching methods will be most effective. The instructor has many options, when selecting the appropriate instructional method for each student, and for each type of class. It is important that teachers use more than just those they learned while at college.

The following is a list of methods[1] for adding variety and interest to industrial technology education programs. Combinations and permutations of this list are not only possible, but are desirable and should be encouraged. But methods alone will never be sufficient. The ultimate success of these as well as other techniques depends on the innovativeness, interest and skill the teacher exhibits in presenting the material.

- Community resources
- Conceptual learning
- Conference
- Contract
- Cooperative
- Demonstration
- Discovery
- Discussion
- Enterprise
- Exercise approach
- Field trip
- Group project
- Guest speakers
- Individualized instruction
- Inquiry
- Lecture
- Mass production
- Problem solving
- Production
- Research and experimentation
- Role playing
- Seminar
- Student personnel system
- Show and tell
- Team teaching
- Work study
- Written or oral reports
- Case study

Instructional methods must be selected to capitalize on the unique needs of students in specific locales. The teacher of industrial technology education programs must be alert to the resources of the community being served. Not only must teachers be alert to resources, they must also be aware of opportunities for integrating these resources into the instructional program. All resources such as speakers, industrial visitations, films, slides, tapes, learning packages and bibliographical resource materials must all be evaluated on the basis of their merit to the instructional program. Figure IV-4 provides some useful guidelines for the selection of teaching methods.

---

[1] Assembled from a variety of state guides, e.g., Texas, Iowa, Missouri . . .

Figure IV-4

Guidelines for the Selection of Delivery Systems[1]

- The best procedure usually is to select the least elaborate and least costly strategy that will apparently enable the learner to acquire the desired capability.
- All things being equal, well-illustrated, step-by-step verbal instructions with feedback to the student constitute the most practical, effective and efficient strategies for most types of learnings.
- If an objective is accomplished in less time with one strategy than another, it is more efficient. If the retention or transfer of the information or skill learned is greater for one strategy than another, then it is more effective for reaching that objectives. When determining the approach to be followed, the best estimate of both efficiency and effectiveness will have to be followed.
- Try to select flexible strategies that can be adapted to student needs, problems and interests.
- Strategies that give students an opportunity to share in goal-setting, learning experiences and evaluation often produce better results.
- Student need an opportunity to work with strategies that provide opportunities to inquire, to analyze, to explore, to be active, to create and to initiate.
- The strategy selected should give the teacher an opportunity to observe student progress

---

[1] Introduction to Vocational Education Instructional Management, 1984.

4. Meeting Individual and Special Needs

All students have individual differences and special learning needs. Traditionally, however, discussions related to special needs have centered on the handicapped, but students with other individual differences must also be considered. Provision must be made for: educationally disadvantaged, economically disadvantaged, limited English proficiency (LEP), gifted students and those with diverse cultural backgrounds. Additionally, students' preferred learning modes must be considered when planning instruction. Some students simply learn more, more efficiently, and more effectively when presented information in visual, auditory and kinesthetic means. Educational methods and procedures, instructional programs and materials, and school facilities must be modified for the purpose of individualizing programs and instruction to ensure that all students will develop to their fullest potential.

Federal legislation and teacher concern has provided the impetus to modify existing educational practices for learners with special needs. Such legislation is reflected in Public Law 94-142, the Education for All Handicapped Children Act of 1975, the Vocational Educational Amendments of 1976, sections 503 and 504 of the Rehabilitation Act of 1973, and more recently, the Carl D. Perkins Vocational Education Act of 1984 (P.L. 98-524) and Public Laws 99-198 and 94-198. All of these laws emphasize the need to identify and infuse educational strategies designed to provide viable educational programs for special needs students. Furthermore, the legislation requires public education to provide instructional programs which will be the least restrictive educational alternative for handicapped learners.

Identifying Special Needs Learners

Industrial technology education professionals typically need not be concerned with detailed identification procedures for special needs learners, because they are the responsibility of other members of the education team. However, ITE professionals should become familiar with some general characteristics of learners who are identified as "special needs" in order to better plan appropriate educational learning experiences and to contribute to the identification process when needed.

It should be recognized that the term "special needs" is an inclusive term which describes students with characteristics which may impede their ability to develop their maximum potential in unmodified programs. A broad understanding of the unique learning characteristics of students who are handicapped, disadvantaged, limited English proficiency, or gifted/talented will be helpful to ITE professionals in modifying programs to accommodate students with special needs. The following material lists and describes characteristics pertaining to special learning needs.

Learner Characteristics[1]

Disadvantaged. Disadvantaged students have academic or economic disadvantages which impair their ability to function in regularly structured school programs. These students typically may be members of families with low incomes, low or underachievers, from culturally restricted backgrounds or with limited English proficiency (e.g. unfamiliar with American customs or the English language). Generally disadvantaged students are of normal or above intelligence but they fail to achieve in the regular school.

Academically disadvantaged students often display language difficulties, reading or writing problems, severe computational difficulties, or other general learning problems. These students may be frequently absent from school, have a short attention span and display low motivation when in class. They are often self-conscious, easily discouraged, have low self-esteem and express feelings of isolation.

Economically disadvantaged students typically are members of families whose incomes are below the national poverty level, have parents who are unemployed or are recipients of public assistance. Generally, these students exhibit many of the same behaviors as academically disadvantaged students.

---

[1] These sections were adapted from fiscal year 1984-86, State Plan for Part B of the Education of the Handicapped Act, n.d., and Special Needs Guide for Industrial Arts Programs, Blacksburg, VA: Virginia Polytechnic Institute and State University, 1981.

Limited English Proficiency (LEP). Limited English Proficiency means individuals who were not born in the United States or whose native language is other than English; who come from environments where a language other than English is dominant; who are American Indian and Alaskan native students and who come from environments where a language other than English has had a significant impact on their level of English language proficiency; and who by reasons thereof, have sufficient difficulty speaking, reading, writing or understanding the English language to deny such individuals the opportunity to learn successfully in classrooms where the language of instruction is English or to participate fully in our society.

Gifted and Talented. Gifted and talented students are those who, by virtue of outstanding abilities are capable of exceptionally high performance academically, physically, or creatively, However, these students will not live up to their full potential unless a challenging instructional environment is provided. The gifted also have unique needs and, as a result, they require enriched and challenging activities guided by a caring and stimulating teacher. In fact, unless they are challenged, these students' talent and creativity may turn toward disruptive behavior. Teachers should not assume that gifted children will be able to take care of themselves because of their superior intelligence.

Handicapped. Handicapped students are learners who have specific or general handicapping conditions that may interfere with their functioning in a regular school environment. These handicaps may be sensory, physical, emotional, or any combination of the three. There are several terms used to classify students with handicapping conditions. Among these are the mentally retarded, hearing impaired, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, other health impaired, deaf-blind, multi-handicapped and learning disabled. Because of these impairments, handicapped students may need special education and related services.

ITE professionals will most often be providing educational experiences for those students who fit the category of "high-incidence" handicapped (i.e., those who comprise approximately 80% of the total population of handicapped learners). Among these students are the learning disabled, mildly retarded, speech impaired, and mild- to moderate-hearing or visually impaired. These students have been able to achieve success in the regular school environment when provided with supportive services and modifications in educational curriculum and teaching strategies.

Occasionally "low incidence" handicapped children may also be placed in regular ITE programs. However, most will be placed in self-contained situations such as "sheltered workshops" or other institutional settings where their needs are more appropriately met. Among the students who fall into this category are the severely and profoundly retarded and the severely emotionally disturbed. Profoundly deaf or blind and orthopedically handicapped individuals also fall into the low incidence category. However, because of their general learning potential some have been able to function successfully in regular access/barrier-free school programs.

The placement of low incidence learners in a least restrictive environment must be determined through an extensive evaluation conducted by qualified specialists. **ITE educators should be involved in the evaluation procedure, particularly to help ascertain a student's potential to function in an ITE learning environment, and the subsequent development of appropriate portions of the individualized educational plan.** Generally these special needs students will require support services in addition to an access/barrier-free building. Examples of such support include: interpreters, educational tutors/aides and adaptive production jigs or fixtures.

The following provide a brief description of various handicapping conditions. While not a totally inclusive listing, these characterizations will facilitate a better understanding for ITE professionals of the general, physical, intellectual and social characteristics of the handicapped.

- The "mild-moderate" mentally retarded are those students who are capable of academic, social and vocational training, but who require specialized instruction to realize maximum skill development and meaningful integration into adult society.

- The "severely" mentally retarded are those students who have potential for training in self-care, social adjustment, and vocationally--related areas rather than academic ones. During adulthood they may function effectively at home and/or in specialized situations such as sheltered workshops and supervised living environments.

- The "profoundly" mentally retarded are those students who are retarded to the extent that they are capable of very little self-care and must have constant attention to survive.

- Learning disabled students have normal or above average intelligence but exhibit a specific learning disorder in one or more basic processes involved in understanding or using spoken or written language. Their learning problems are not due to visual, hearing, motor or environmental handicaps. Typical disorders which may be the cause of a learning disability are perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia.

- Severely emotionally disturbed or severely behaviorally handicapped students exhibit undesirable behaviors or feelings over a long period of time that adversely affects educational performance. Students in this category have an inability to learn which cannot be explained by intellectual, social or health factors. School-related characteristics may include poor interpersonal relationships with peers and teachers; a general pervasive mood of unhappiness or depression; periods of self-stimulation or withdrawal; and a tendency to develop physical symptoms or fears associated with personal or school problems. The term includes autistic or schizophrenic individuals, most of whom may profit substantially from instruction as determined through comprehensive and specialized evaluation.

- Visually impaired students are handicapped in a normal educational program by their difficulty or inability to see. Under this heading, students are classified as partially sighted, legally blind or profoundly blind. However, many have demonstrated the ability to develop proficiency in using ITE equipment with some modification of the learning environment.

- Partially sighted or legally blind students are those who can learn to read print, but whose vision is limited (even with corrective devices), and who need instructional modifications in order to succeed in a regular educational program. Partially sighted persons have a vision of 20/70 to 20/200 after correction with lenses. Legally blind persons have less than 20/200 vision with glasses.

- The profoundly blind have the most severe visual impairment. They cannot tell light from darkness and as a result, cannot see print. Often they can benefit from instruction in braille. These students must depend totally on their other senses to function satisfactorily in an educational program.

- Orthopedically handicapped students are normally limited in mobility, sitting and/or the use of tools and equipment because of muscular, skeletal or neuromuscular impairment. Included in the related causes of orthopedic handicaps are cerebral palsy, spina bifida, curvature of the spine, muscular dystrophy, hemophilia or other defects in legs, arms, neck or hips. Orthopedically handicapped students are generally average or above average in intelligence and can function in a regular school environment which has been adapted and made barrier/access free.

- Hearing impaired students have a loss of hearing which affects their performance in a regular educational setting. Their sense of hearing is limited in many ways. For example, if students cannot hear the ordinary sounds of activity around them, then they are considered deaf. However, when students can hear, but only hear part of what is said, then they are considered hard-of-hearing. Hearing losses may be mild, moderate, severe or profound

- Hard of hearing individuals have some ability to hear and understand the spoken word. Although some words may be audible, the pitch and frequency of these sounds may make it difficult for these individuals to ascertain their meaning. Sounds are not necessarily just softer to these individuals but may also be garbled and distorted. Some hard-of-hearing students may require the use of hearing aids and/or rely on lip reading. Likewise, deaf individuals must always require the use of an interpreter and/or lip reading.

- Speech impaired students normally have speech patterns which are noticeably different from the norm. There are many forms of speech impairment, ranging from complete inability to speak to minor articulatory deficits. Furthermore, there are many causes for speech difficulties, ranging from delayed speech and hearing impairments to cerebral palsy and cleft palate.

- Other health-impaired students are so categorized because they demonstrate limited strength, vitality and alertness. The conditions of health-impaired students are caused by chronic health problems such as heart conditions, tuberculosis, rheumatic fever, nephritis, hepatitis, asthma, epilepsy, leukemia or diabetes.

- Multi-handicapped students exhibit combinations of two or more of the previously mentioned handicaps. For example, a student may be deaf and blind or orthopedically disabled and mildly retarded. As a result, special accommodations are necessary to facilitate their educational development.

Accommodating Special Needs Students in the ITE Program

Educational methods and procedures, instructional programs and materials and school facilities must be modified for the purpose of tailoring instruction to serve special needs students in ITE programs. The teacher cannot accomplish this task alone. Other professionals from such areas as special education, rehabilitation, school psychology, guidance and the community in general can help. Through cooperative efforts ITE programs can effectively incorporate the fundamental elements for success and therefore be as appropriate for special needs learners as they are for other students.

The teacher remains the central factor governing the special needs student's potential for success in ITE. The teacher's attitude, personality and self-concept will help govern his/her performance. Teaching students from special needs populations is very much like working with non-special needs students. Each needs empathy, guidance/direction, understanding and an appropriate and challenging learning environment carefully managed by a knowledgeable teacher. There are however, some subtle, as well as obvious, characteristics of certain learners that require a change of teaching style. For example, teachers who tend to "kid" or "tease" their students may find that students with poor self-image or low self-esteem may interpret this as "ridicule," "cruel," and "inappropriate punishment". Likewise, special needs students want "empathy" -- understanding of their limitations and the desire to help remediate them (and also build upon strengths) -- rather than "sympathy." Teachers must continue to be firm but fair, consistent and yet flexible, and concerned and caring enough to challenge special needs students to achieve new goals and experiences.

To help provide such an environment, many useful items, for both instructor and student, are available from the Special Education Dissemination Center (SEDC). Although not exclusively concerned with ITE resources, the center distributes and loans many items with direct value to our field. Contact them directly for their lending catalog, a description of services, their conferences and to be certain that your district is on their mailing list:

Ms. Judy Cunningham, Director
Special Education Dissemination Center
401 E. Stewart Road
University of Missouri-Columbia
Columbia, MO 65211
(314) 882-3594
(800) 397-7340

Much additional information and help is available from the profession's many special needs resources and guides. The ITE instructor with a need to better serve special needs students is advised to secure some of the many guides listed in this Chapter's resource section (part 8).

5. Providing for Equity

When discussing equity it is important to remember that the term encompasses more than just sex fairness. It means being fair and impartial to people regardless of their sex, race, age and/or religion. Most materials that have been published recently have been revised to be sex fair. Additionally many references to aid the ITE teacher in evaluating materials and practices on the basis of sex bias have been developed. Furthermore, most of these materials can be adapted to other equity targets if their terms related to sex fairness are replaced with others related to race, religion or age.

To insure quality programming, ITE instructors should review all curriculum materials to eliminate biases. Of course, elimination of biased language will not eliminate biased conduct, but as the language is liberated from biased usage and assumptions, people will begin to share more equitably in social and economic realms.

The new thrust towards equity emphasizes action, not only in recruitment but also retention. ITE instructors are therefore encouraged to assess why target group students do not return to the program if they leave. Additional assistance with equity thrusts may be obtained from:

Ms. Georganna Beachboard, Director
Special Vocational Services
Vocational Adult Education
Department of Elementary and Secondary Education
P.O. Box 480
Jefferson City, MO 65102
(314) 751-2661

Judy McQuitty
Sex Equity Coordinator
Project SERVE
10 Industrial Education
Instructional Materials Laboratory
University of Missouri-Columbia
Columbia, MO 65211
(800) 392-2717

Similarly, recruitment and program admission policies and procedures must be evaluated in order to eliminate any unnecessarily restrictive statements. Poorly phrased or overly restrictive policies could bias class participation in unintended ways. Course prerequisites, if any, must be examined in the same way to determine if they are unnecessarily restrictive or are inadvertently prejudiced.

Change is a slow process and traditions are not relinquished easily. Industrial technology educators must examine their own beliefs and assess their appropriateness. If they are dedicated to quality education for all students, ITE teachers must remove those barriers which prohibit equity for all potential students. Though industrial technology education/industrial arts has been an integral part of the school curriculum for more than three-quarters of a century, there are students, parents and school personnel who may not be aware of this fascinating and important area of the curriculum and its potential for non-traditional students.

Efforts to bring about a better understanding of ITE will help everyone appreciate its benefits for all students. Commitment for reaching all students involves some concrete action such as examining attitudes and behaviors, carefully choosing instructional materials and making conscious efforts to help people outside the classroom become aware of the accomplishments made by Industrial Technology Education. Figure IV-5 shows some of the strategies that will help in working towards increased equity.

Figure IV-5

Equity Strategies for Classroom Teachers[1]

1. Be direct with students about bias. Point out racist or sexist bias in books or materials. Help them learn to identify sources of bias and important omissions in the materials.
2. Develop classroom activities around identifying bias found in television, textbooks, movies, library books or magazines.
3. Incorporate the development of critical reading skills as an instructional objective for all your teaching, not just when special efforts are being made to identify bias in materials.
4. Identify or develop supplementary materials which can help "correct" some of the bias of available materials.
5. Assign student papers, themes, term papers or other activities on topics or persons not usually covered in textbooks or materials.
6. Invite local resource persons into your classroom to provide additional information and work with students on special projects and activities.
7. Ask students to rewrite materials or write their own materials on subjects omitted from the textbook or write the material from another person's point of view.
8. Use bulletin boards, posters, pictures, magazines and other materials to expose students to information commonly excluded from traditional materials.
9. Develop a classroom collection of non-racist, non-sexist reading materials for students. Identify books that students may be encouraged to seek out in their personal reading.
10. Be proactive in recruitment of nontraditional students and organize informational activities designed to attract nontraditional students.
11. Create an industrial technology education day where students in 6th or 7th grade can have hands-on experiences with technology.
12. Develop a slide-tape presentation targeted on non-traditional populations to encourage their participation in ITE.

---

[1] Adapted from Guidelines for the Creative Use of Biased Materials in a Non-Biased Way.

6. Incorporating Student Organization Activities

The human species is basically gregarious. We find comfort and satisfaction in the fellowship and acceptance of peers. Through interpersonal relationships and communication, each contributes, either as a leader or follower, to group activities. Throughout life humans join and participate in many diverse group activities.

This type of organized group activity is typically less formal than the school and its atmosphere develops important group interaction and social skills through the vehicle of student organization and club activities. ITE club activities should be an integral part of this important socialization process. As essential elements in the educational experience, these activities naturally fall under the supervision of industrial technology educators.

At the national level the industrial technology education/industrial arts youth organization is the American Industrial Arts Student Association (AIASA). The name of the student organization, that represents Industrial Technology Education in our state, is the Missouri Industrial Technology Education Student Association and it is referred to as MITESA. Both of these organizations offer a great deal of assistance in the operation of a local student organization and affiliation with both is strongly encouraged. For example, they provide student and advisory handbooks, activity guides, organizational recommendations, contest standards, and motivating audio-visuals. Figure IV-6 highlights the goals and objectives of MITESA.

Many activities of this organization should be co-curricular, that is, they should interface and interact with the curriculum areas in the school. For example, research could be conducted in conjunction with the English department, specific experiments could be performed jointly with the physics, chemistry or mathematics departments. These examples are only intended to spark ideas about ways in which interaction can take place. There are virtually unlimited opportunities for these kinds of activities. For further information and specifics on the operation of a local MITESA chapter contact (through Missouri's ITE Supervisor) the state organization for copies of their latest publication, Missouri Industrial Technology Education Student Activities Guide (Hart, 1987).

Participation in the Missouri Industrial Technology Education Awards Program competition is a "sure-fire" way to encourage students to greater heights. There is something about competition that brings out the best in many. In recognizing this MITESA advisors, i.e., teachers just like you, often establish competition among the chapters in the state. Additionally, the MITEA, together with MO DESE and university support is working towards a Technology Exposition and competition. Envisioned are on-site student competitions both individual and group. Additional information and guides will be available from MITEA, UMC's Instructional Materials Laboratory and/or the State ITE Supervisor as they are developed. Examples under consideration include:

- Technology problem-solving by three member teams
- Technological literacy knowledge contest
- Drafting contest
- Computer assisted design and drafting contest
- Manufacturing contest (e.g., mass production)
- Metric 500 contest
- Energy & power contest (e.g., mousetrap car, rockets, etc.)
- Bridge/Structure building contest
- Design problem (e.g., egg drop)
- Electronic troubleshooting contest
- Computer simulation contest
- Programming contest
- Robot challenge contest

Figure IV-6

Goals & Objectives of the Missouri Industrial Technology Education Students Association

Goals:

- To promote leadership, fellowship, and scholarship among students throughout the state of Missouri.
- To promote industrial technology education programs in the public schools of Missouri.
- To increase the knowledge and understanding of our industrial society and its relationship to technological advancement.

Objectives:

1. To develop through group action the ability of members to plan together, organize and carry out worthy activities and projects.
2. To provide good leisure time activities and hobbies.
3. To promote high standards of craftsmanship and safety.
4. To assist in providing guidance and counseling for students enrolled in industrial technology education programs in making informed and meaningful choices in selected occupational fields.
5. To prepare individuals for enrollment in advanced or highly skilled vocational and technical education programs.
6. To develop consumer knowledge.
7. To provide occupational information and instructions pertaining to a broad range of occupations.
8. To provide exploratory experiences in laboratories and observations in business or industry to acquaint students with jobs in the different occupations.
9. To assist industrial technology education students in creative expression.
10. To promote and encourage all students to utilize basic essential skills taken from the objectives of the BEST, CAT and Core Competencies Tests.

7. Teaching Employability Skills

Employability skills refer to competencies possessed by individuals which allow them to get and keep a job. Occupational skills associated with specific jobs are not employability skills. Rather, what is being referred to are things such as dependability, punctuality and general work attitudes. Typically employability skills involve competencies in three primary areas: personal characteristics, job seeking techniques and entrepreneurship awareness.

Why should employability skills be of concern to ITE teachers? There are several reasons. Many ITE students will go on for further training in vocational education programs and the skills learned in ITE will make it a great deal easier for them to succeed. Many students find work after high school and will be in need of these skills in order to keep their job. Some students work part time while going to school and employability skills make it possible. Still other students drop out of formal education and attempt to find work on a full time basis. Without these skills they are likely to be doomed to failure. Figure IV-7 lists a set of employability competencies in a format that provides ITE instructors a convenient way to record mastery. The core course competency lists provided in part 4 of Chapter VIII also include important employability skills.

There are three major components of employability skills education. Skills needed to get a job, and skills necessary to keep a job are the first two. Both are equally important and neither should be overlooked. It stands to reason that in order to keep a job you must first get one. Conversely it does little good to get a job if you can't perform well enough to keep it. The third component, entrepreneurship awareness, represents job creation for oneself, rather than working for someone else.

The first order of business for anyone looking for work should be the acquisition of job seeking skills. These are skills that allow individuals the opportunity for employment and to show how well they are able to perform on the job. Pertinent questions to ask when planning employability skills instruction are:

- How do you apply for a job over the phone?
- How do you answer a newspaper advertisement of a job?
- How do you interview for a job?
- What type of clothing should be worn to an interview?
- What information should be included in a resume?
- Are there any techniques that will make interviews easier?
- How is a job application form completed?
- Who and what are personal references?
- What should be done when offered more than one job?
- What criteria should be used to evaluate job offers?

Other than specific occupational skills, several personal qualities have been identified that employers expect and demand of employees. In the past these have, mistakenly, been referred to as personality traits. Personality traits are difficult, at best, to change. Employability skills on the other hand are learned and can be taught in a systematic, logical manner. Some of these traits are:

- The ability and willingness to follow directions.
- Punctuality.

- Reliability
- The ability to get along with co-workers.
- Showing initiative.
- Demonstrating respect for others.
- The ability to be self directive and complete tasks unassisted.
- Dependability
- The ability to communicate with others.
- Being cooperative.
- Perseverance.
- Willingness to learn.
- Ability to accept, and profit from, criticism.
- Personal hygiene.

Personal Characteristics

Directions:

Rate the student by checking the appropriate number on each scale. The ratings should be based on your observation of the student rather than on the grades given in class.

Rating Scale:
3 Above Average
2 Average
1 Below Average

Job Seeking Techniques

Directions:

Evaluate the student by checking the appropriate number or letter to indicate the degree of competence. The rating for each task should reflect employability readiness rather than the grades given in class.

Rating Scale:
3 Mastered
2 Requires Supervision
1 Not Mastered
N No Exposure

Entrepreneurship Awareness

Directions:

Evaluate the student by checking the appropriate number or letter to indicate the degree of competence. The rating for each task should reflect employability readiness rather than the grades given in class.

Rating Scale:
3 Mastered
2 Requires Supervision
1 Not Mastered
N No Exposure

---

3 2 1 **Personal Characteristics**

☐☐☐ 1. RELATIONS WITH OTHERS (effectiveness in working with students, instructors and others; cooperation; shows respect)

☐☐☐ 2. DEPENDABILITY (attendance; punctuality; adherence to schedules and deadlines; consistency and results; perserverence)

☐☐☐ 3. WORK ATTITUDES (willingness to learn; willingness to accept & profit from evaluation; enthusiasm; initiative; commitment; pride in work)

☐☐☐ 4. COMMUNICATION (listening; speaking and non-verbal skills; effectiveness in communicating with students, teachers and others)

☐☐☐ 5. PERSONAL HYGIENE & GROOMING (personal health care & cleanliness; dresses and maintains self appropriately)

OTHERS (specify):

☐☐☐ ____________________

☐☐☐ ____________________

3 2 1 N **Job Seeking Techniques**

☐☐☐☐ 1. Apply information about self and job opportunities in career decision making

☐☐☐☐ 2. Write a resume

☐☐☐☐ 3. Prepare a job application form

☐☐☐☐ 4. Write letters of application and acceptance

☐☐☐☐ 5. Arrange for personal references

☐☐☐☐ 6. Apply job search techniques

☐☐☐☐ 7. Arrange a job interview

☐☐☐☐ 8. Apply job interview techniques

☐☐☐☐ 9. Evaluate job offers (actual or simulated)

Others (specify):

☐☐☐☐ ____________________

☐☐☐☐ ____________________

☐☐☐☐ ____________________

3 2 1 N **Entrepreneurship Awareness**

☐☐☐☐ 1. Describe five characteristics of a free enterprise economic system (ownership of property, profit motive, risk taking, competition, supply & demand)

☐☐☐☐ 2. Name four forms of business ownership (sole proprietorship, partnership, corporation, cooperative)

☐☐☐☐ 3. Describe advantages and disadvantages of small business ownership.

☐☐☐☐ 4. Identify steps necessary to start a business (evaluate need, site selection, marketing plan, financial plan, management plan)

☐☐☐☐ 5. Identify business opportunities related to training

☐☐☐☐ 6. Identify personal traits of the entrepreneur (versatility, aspirations, energy, integrity, adaptability, etc.)

Others (specify):

☐☐☐☐ ____________________

☐☐☐☐ ____________________

Figure IV-7 Employability Competency Profile[1]

---

[1] Instructional Materials Laboratory, University of Missouri-Columbia

Notes:

8. Resources

________. AIASA Guide for Industrial Arts Programs. Blacksburg, VA: Virginia Polytechnic Institute and State University, 1981.

________. AIASA Guide for Industrial Education Programs. No. 278c. Macomb, IL: Illinois State Board of Education, n.d.

________. Contemporary Approaches for Teaching Technology. Reston, VA: American Council of Industrial Arts Supervisors, 1983.

________. Creative Ways to Supplement Biased Materials: An Instructional Unit in Sex Equity. Jefferson City, MO: Special Vocational Services, Missouri Department of Elementary and Secondary Education, n.d.

________. Elementary School Industrial Arts. Salem, OR: Oregon Department of Education, 1986.

________. Employability Skills Course Outline. Draft. Nebraska: Father Flanagan High School/Boys Town High School, December 1986.

________. Guidelines for Sex-Fair Vocational Education Materials. Princeton, NJ: Women on Words & Images, n.d.

________. Guidelines for the Creative Use of Biased Materials in a Non-Biased Way. Women on Words and Images. Jefferson City, MO: Rptd by Missouri Department of Elementary and Secondary Education, 1979.

________. Handbook for Industrial Arts Education. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, 1977, [IA-2-1].

________. Introduction to Vocational Education Instructional Management. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, May 1984.

________. Iowa Industrial Arts Handbook for Incorporating Industrial Arts/Career Education into Elementary Curriculum. Des Moines, IA: Iowa Department of Public Instruction, 1981.

________. Resources in Technology. Volumes I, II, III. Reston, VA: International Technology Education Association, 1984, 1985, 1986.

________. Science & Math Concepts Corequisite or Prerequisite to Competencies in Communications Technology, Energy Utilization Technology, Production Technology & Transportation Technology. Dekalb, IL: Northern Illinois University, 1985.

________. Sex Equity Guide for Industrial Arts Programs. Blacksburg, VA: Virginia Polytechnic Institute and State University, 1981.

________. Sex Equity Guide for Industrial Education Programs. No. 278d. Macomb, IL: Illinois State Board of Education, n.d.

________. Special Needs Guide for Industrial Arts Programs. Blacksburg, VA: Virginia Polytechnic Institute and State University, 1981.

________. Special Needs Guide for Industrial Education Programs. No. 279c. Macomb, IL: Illinois State Board of Education, n.d.

________. State Plan for Part B of the Education of the Handicapped Act (as amended by P.L. 94-142), FY 1984-86. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, n.d.

________. Technology Activities. Idea Book 1. Reston, VA: International Technology Education Association, 1986.

________. Technology Education: A Perspective on Implementation. Reston, VA: American Industrial Arts Association, 1985.

________. Technology Exposition. Unpublished draft plans for activities, displays and contests. Jefferson City, MO: Missouri Industrial Arts Supervisor, Department of Elementary and Secondary Education, 1987.

________. Technology Learning Activities. Albany, NY: New York State Education Department, 1984.

________. VICA Guide for Industrial Education Programs. No. 278b. Macomb, IL: Illinois State Board of Education, n.d.

Boben, Donna K. Guidelines for Equity Issues in Technology Education. Reston, VA: International Technology Education Association, 1985.

Boyd, Gardner & Miller, W.R. Teaching Elementary Industrial Arts. Urbana, IL: Griffon Press, 1983.

Buffer, James J. Jr. & Scott, Michael L. Special Needs Guide for Technology Education. Reston, VA: International Technology Education Association, 1985.

Clendenning, Lee R. & Dickey, Ouida W. Technology, Free Enterprise, and Careers Through Industrial Arts. Preliminary Draft. Mount Berry, GA: Berry College and Georgia State Education Department, 1983.

Hart, Dwight. Missouri Industrial Technology Education Student Activities Guide. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, 1987.

Lister, Glen. Technology Activity Guide 1. Albany, NY: Delmar Publishers, Inc., 1987.

Maley, Donald. (Ed). Math/Science/Technology Projects for the Technology Teacher. Monograph. Reston, VA: International Technology Education Association, 1985.

Maley, Donald. Research and Experimentation in Technology Education. Reston, VA: International Technology Education Association, 1986.

Mathews, Martha & McClure, Shirley. Try it, You'll Like It! A student's introduction to nonsexist vocational education. Washington, DC: Resource Center on Sex Roles in Education, National Foundation for the Improvement of Education, 1978.

McCrory, David L. & Maughan, George R. Resources in Technology. Worcester, MA: Davis, n.d.

Miller, W.R. & Rose, H.C. Instructors and Their Jobs. Chicago, IL: American Technical Society, 1975.

Shackelford, Ray & Henak, Richard. Making Industrial Education Facilities Accessible to the Physically Handicapped. Reston, VA: International Technology Education Association, 1983.

Tischler, Morris. Thoughts on Learning: Concepts for Planners, Supervisors, Teachers, Writers, Salesmen. Baltimore MD: Science Instruments Co. (6122 Reisterstown Road, Baltimore, MD 21215-3487), n.d.

Walker, Hattie M. Instructional Resource Guide for Competency Based Education in Industrial Arts -- Exploring Technology. Richmond, VA: Virginia Department of Education, 1983.

Chapter V

Organizing and Managing the ITE Program

1. Introduction

"Even the best laid plans can go astray!" To be sure, but when they do it is most often a problem with organization, management and follow-up. Typically the ITE instructor's ideas are sound and well-founded -- but, if and when problems arise, it is his/her action or follow-through that is lacking -- and often not due to any personal failing but rather because of a lack of support. Consequently, this chapter's intent is to help industrial technology educators organize and manage programs more effectively. As such, this chapter shares the collective experience of many of the profession's best practitioners.

To this end, this chapter's main parts present guidelines to help find and make effective use of key resource people, to use available support systems, to use advisory committees to achieve the ITE program's goals, and to organize and manage the program better. Properly organized and managed, these resources will help students achieve more -- and with less strain on your part.

Notes:

2. Accessing Key Resource Personnel

It is impossible for anyone to be all things to all people. This is especially true in the world of technology with its exponential rate of growth and change. Therefore the ITE teacher must be aware of key resource personnel who are available to offer assistance. Typically nine categories of resource people are used most often.

- Local school and school system personnel
- Other local, state and national members of the profession
- University faculty
- Department of Elementary and Secondary Education (DESE) personnel
- Other Missouri state department/divisions in related areas, e.g., The Department of Health and Human Services, Economic Development and the like
- Educational association/staff members
- State and national special focus groups
- Individuals employed in technology (business & industry)
- Professionals in the community

Within the local school and system, several groups of resource personnel can provide a majority of the general assistance required. Quite naturally the first people to come to mind are supervisors, principals and superintendents. In addition, counselors, special education teachers, vocational resource educators and one's peer teachers are all excellent sources of assistance. Many of these are support personnel with the responsibility to assist the ITE teacher to achieve his/her program goals and objectives.

The Missouri Department of Elementary and Secondary Education (DESE), also offers a great deal of assistance. It is important to note that its personnel's help is not limited to information on forms and finances. DESE staff have a wide range of contacts with other schools, both within the state and beyond it. Questions about what to teach, with what methods and how well these methods work are most appropriate for them to field as are questions about what is happening elsewhere.

Similarly, the state colleges, universities and the University of Missouri-Columbia (as listed in Table V-1) all provide excellent sources of information. Industrial education/industrial technology personnel within these institutions have wide experiences with all types of technology and programs. Their faculty have diverse backgrounds, considerable professional involvement and they often conduct research in areas of special interest on a regular basis. They frequently offer seminars, courses, workshops and many types of in–service programs. However, don't wait until these opportunities present themselves. Call or meet with them to get your question answered. These faculty will be happy to assist you in solving a problem. If the problem is out of their area of expertise they will most certainly direct you to a more appropriate source of information and help. Table V-1 lists the names of colleges and universities in Missouri, along with department titles, addresses and phone numbers. Universities in other states are found in the Industrial Teacher Education Directory.

Professional trade associations involved with any facet of any particular technology in question are other logical and important sources for help. These associations are found at local, state and national levels. Don't forget any of them. Much valuable assistance can be gotten from these sources. Table V-2 presents a sample of such organizations. ITE instructors can identify additional appropriate associations by consulting the Encyclopedia of Associations or other association directories in the reference section at their nearest library.

Don't forget business and industry or the local community's professionals either. Frequently equipment, supplies and other materials are available just for the asking. Business and industry like to help education because the schools supply them with skilled manpower. Some of these contacts are, or should be, members of your advisory committee. Use these contacts regularly on both a formal and an informal basis. Show up at their places of business, just to be friendly, from time to time. Don't just show up or phone only when you want something. Offer your services when it is feasible for you to be of assistance to them and their firms. This type of partnership is one of sharing and cooperation and should be one of mutual benefit.

Table V-1

Missouri Universities with ITE Programs[1]

Central Missouri State University
Warrensburg, MO 64093

- Department of Electricity and Electronics
  Dr. Hal Sappington
  Phone (816) 429-4940

- Department of Graphics
  Dr. William A. Downs
  Phone (816) 429-4727

- Department of Manufacturing and Construction
  Dr. Jack Landers
  Phone (816) 429-4439

- Department of Power and Transportation
  Dr. John Horine
  Phone (816) 429-4975

- Department of Safety Science and Technology
  Dr. Robert Ulrich
  Phone (816) 429-4626
  Phone (314) 651-2104 or 2114

Lincoln University
Jefferson City, MO 65101

- Department of Technology and Industrial Ed.
  Dr. Foster Fuller
  Phone (314) 751-2325 ext. 395

Missouri Southern State College
Newman & Duquesne Roads
Joplin, MO 64801-1595

- Industrial Arts Department
  Dr. Jim Maupin
  Phone (417) 624-8100 ext. 305
  Phone (417) 334-6411

Northeast Missouri State University
East Normal Street
Barnett Hall 120
Kirksville, MO 63501

- Department of Industrial Science
  Dr. Robert L. Stephens
  Phone (816) 785-4572

Northwest Missouri State University
Maryville, MO 64468-6001

- Department of Technology
  Dr. Al. A. Andrews
  Phone (816) 562-1190

Southeast Missouri State University
900 Normal Avenue
Cape Girardeau, MO 63701

- Department of Industrial Technology & Education
  Dr. Robert Cox

Southwest Missouri State University
901 S. National Avenue
Springfield, MO 65804

- Department of Industrial Technology
  Dr. Orin R. Robinson
  Phone: (417) 34-6411

The School of the Ozarks
Point Lookout, MO 65726

- Department of Technology
  Dr. Eldon Divine

University of Missouri-Columbia
105 Industrial Education Building
Columbia, MO 65211

- Industrial Education
  Dr. Niel A. Edmunds
  Phone (314) 882-2782

---

[1] From Industrial Teacher Education Directory, 1986-87.

Table V-2

Selected Trade Associations Relevant to ITE[1]

- American Foundrymans Society
- Graphic Arts Technical Foundation
- American Society for Testing and Materials
- Electronics Industry Association
- National Paint Council
- Society of Plastic Engineers
- American Society for Testing & Materials
- National Association of Manufacturers
- Western Woods Products Association
- Society of Manufacturing Engineers
- American Petroleum Institute
- Association of General Contractors
- National Safety Council
- American Society for Metals
- American Welding Society
- National Association of Home Builders
- National Paint and Coatings Association

---

[1] Addresses and descriptions are available in the Encyclopedia of Associations.

State and Federal government agencies in specific service areas can be of immeasurable assistance with problems in their area of expertise. Typically, the types of things that will be involved will not necessarily, be technological in nature, although, they may involve technology, either industrial, medical or some other kind. After all, technology pervades virtually every aspect of human endeavor. Some of the governmental agencies that can provide assistance are presented in Table V-3.

Educational associations on the local, state and national level can be of assistance in many ways. They offer publications, conferences and special-topic workshops and seminars. Membership in this type of association is highly recommended and it can pay off in dividends for students, faculty and the entire school district. Table V-4 lists some of the associations of relevance to ITE.

Table V-3

Useful Federal and State Agencies

Federal

- The U.S. Department of Education
  Mr. Louis Godla
  Program Specialist for Industrial Arts Ed.
  Room 615 Reporters Building
  400 Maryland Avenue, S.W.
  Washington, DC 20202
  Phone: (202) 732-2426

- The Department of Health and Human Services
- Department of Transportation
- Farmers Home Administration

- National Center for Research in Vocational Education (NCRVE)
  Dr. Jay Smink
  The Ohio State University
  1960 Kenny Road
  Columbus, OH 43210
  Phone: (800) 848-4815

- Nuclear Regulatory Commission
- National Aeronautics and Space Administration
- Environmental Protection Agency

State

- Vocational Resource Center
  (Includes Industrial Arts)
  Mrs. Bonnie Stewart, Director
  Room 8, Industrial Education Bldg.
  University of Missouri-Columbia
  Columbia, MO 65211
  Phone: (314) 882-2883
  Toll Free: (800) 392-7217

- Missouri Occupational Information Coordinating Committee
  Ms. Kay Raithel, Director
  421 East Dunklin
  Jefferson City, MO 65101
  Phone: (314) 751-3800

- Missouri LINC
  Dr. Lynda West, Director
  609 Maryland
  University of Missouri-Columbia
  Columbia, MO 65211
  Phone: (314) 882-2733
  Toll Free: (800) 392-0533

- Missouri Council on Vocational Education
  Dr. Donald Claycomb
  Executive Director
  P.O. Box 545
  Jefferson City, MO 65102
  Phone: (314) 751-4384

- Missouri State Agency for Surplus Property
  117 Riverside Drive
  P.O. Drawer 1310
  Jefferson City, MO 65102
  Phone: (314) 751-3415

- Division of Employment Security
- Division of Family Services
- Governor's Committee on the Employment of the Handicapped
- Department of Health
- Departments Labor and Industrial Relations
- Wolfner Memorial Library (for the blind and physically handicapped)
- Job Development and Training Program
- Division of Vocational Rehabilitation

The main two ITE associations are the American Vocational Association's Industrial Arts Division and the International Technology Education Association. Both offer extensive benefits and programs of service to their members. In fact, many in the profession belong and actively participate in both. The Missouri Industrial Technology Education Association serves as the state's representative for both national associations. The Missouri Vocational Association, the state's AVA affiliate, has an Industrial Arts Division which provides programming and an interface to the vocational education system.

The International Technology Education Association (ITEA) and the AVA's Industrial Arts Division are the profession's voice for industrial arts and technology education. Their purpose is to enhance service to youth. Their primary concerns involve the evolution of curriculum and personnel in the profession. Their programs for teachers, students and supervisors are based on the premise that industrial technology education is vitally significant in a world where industry and technology are critical to every aspect of our life. Both state and national associations work to secure federal funding for industrial technology education programs and both have received recognition from the U.S. Department of Education.

The Missouri Industrial Technology Education Association deserves special mention because it is our state's key professional association. Essentially the work of this association is conducted by an elected board of directors and by committees they appoint. The former is representative of the state's eleven regional IA/ITE associations. Some of the MITEA's main activities include:

- Issuing a periodic newsletter
- Conducting the annual regional and state Industrial Technology Education Awards Program for student skill and knowledge competition.
- Organizing professional development conferences several times each year (including the ITE program at the Missouri Vocational Association's July conference.)

State and national special focus groups are associations of individuals with concern for specific groups of individuals. Among these groups are the handicapped, disadvantaged, blind, autistic and minority groups.

Quite frequently some of the best contacts and resources are parents and individuals currently employed within industry. These employees could be local or remote. They could also be personal friends or just casual acquaintances. It must not be forgotten that graduates from our own schools and programs make excellent resources as well. Ultimately, all of the association and group resources amount to individuals. Individuals are our contacts, allies and frequently our friends.

All of the above resources must be looked upon, not only as sources of information and possibly materials and supplies, but also as sources of speakers and demonstrators for our classes. Keeping up to date in all of industrial technology's fields is virtually impossible. If, however, we use external resources to their fullest extent our students will gain an extremely diverse and well grounded education in industrial technology.

Table V-4

Professional Associations Relevant to ITE

International Technology Education
Association (ITEA)*
1914 Association Drive
Reston, VA 22091-12502
Phone: (703) 860-2100

- Council on Technology Teacher Education
- ITEA-Council of Supervisors
- Council of Technology Education Associations
- Technology Education for Children Council

American Industrial Arts Student
Association (AIASA)*
1908 Association Drive
Reston, VA 22091-1502
Phone: (703) 620-1060

American Vocational Association (AVA)*
Industrial Arts Division*
1410 King Street
Alexandria, VA 22314
Phone: (703) 683-3111

Missouri Vocational Association*
P.O. Box 1568 S.S.S.
Springfield, MO 65808

Missouri Industrial Technology Education
Association* and its regional associations*

Technology Education Collegiate Association
1914 Association Drive
Reston, VA 22091-1502
Phone: (703) 860-2100

Missouri Federation of Teachers (MFT)
8420 Delmar, Suite LL2
St. Louis, MO 63124
Phone: (314) 993-6122

Missouri State Teachers Association (MSTA)
407 South Sixth Street
P.O. Box 458
Columbia, MO 65205
Phone: (314) 442-3127
Toll Free: (800) 392-0532

Epsilon Pi Tau
Dr. Jerry Streichler, Executive Secretary
School of Technology
Bowling Green State University
Phone: (419) 372-2425

Missouri National Education Association (MNEA)
612 Eastland
Jefferson City, MO 65101
Phone: (314) 634-3202
Toll Free: (800) 392-0236

Missouri Congress of Parents and Teachers (PTA)
2101 Burlington
Columbia, MO 65201
Phone: (314) 474-8631

* Contact the State Industrial Technology Education Supervisor for current President, address & phone.

Mr. Stephen D. Coffman
Missouri DESE
P.O. Box 480
Jefferson City, MO 65102
Phone: (314) 751-7764

3. Using Available Support Systems

Available support systems are, as might be expected, closely related to the previous topic which highlighted resource people. Key resource personnel are a vital component of any support system. There are, however, some support systems that are not necessarily represented by individuals. Some of these include: state department of education programs, federal programs and physical plant services.

Missouri Department of Elementary and Secondary Education

The Missouri Department of Elementary and Secondary Education offers, on an annual basis, the Industrial Education Grant Awards Program. Guidelines are issued yearly to help ITE instructors apply for these funds. Typically they are earmarked for the improvement of instruction in Industrial Arts/Industrial Technology Education programs. In the past, such funds have been available for exemplary programs, innovative teaching methods, equipment, supplies, copying and dissemination of successful practices. It is strongly recommended that ITE instructors take advantage of this funding to supplement local resources. This enables a more rapid implementation of program change/updating in order to better reflect industry and the rapidly changing technology it employs. Now, in addition to the grant awards programs, ITE instructors have access to Missouri's Excellence in Education Act funds as well as to tuition reimbursement programs. Instructors may contact Missouri's Industrial Arts Supervisor or DESE's public information office for details on current funding possibilities.

Federal programs of interest include the National Diffusion Network. This involves a linkage of centers that disseminate information about carefully evaluated and proven effective programs in all educational fields. Occupational Versatility, a multiple activity industrial exploration program, is one of the nationally disseminated models. The network is accessible through the Missouri Facilitator Center, 310 North Providence Road, Columbia, MO 65201 (314:449-8782).

Special Needs Support

Other sections of this guide (in Chapter IV) have detailed much about the support services available from special needs specialists. Our state has an exceptionally effective network and support system for the disadvantaged, handicapped and minorities. The ITE teacher must take the time to learn how this system's resources can be of most help to him/her in meeting the special needs of his/her students. Teacher aides, vocational resource educators, special instructional material, assistance with remediation and equipment modifications are but some of the resources that can be obtained.

Guidance Support

One of the support systems crucial to the success of ITE programs is the schools' guidance system. For maximum program effectiveness, formal and cooperative relationships are vitally important. Together teachers and counselors, with mutual concern for the students' development, can really accomplish significant goals. As a consultant the guidance counselor can work with the ITE instructor in the area of student self- and career-awareness, showing the latter effective techniques and sharpening his/her observational skills so that he/she can facilitate group processes and individual conferences.

Computer Networking

You expected it didn't you? To use technology to help teach better that is. Well, recently a new computer networking, conferencing and messaging system, called Technology Link[1] was established. With it you can, at a reasonable cost:

---

[1] For subscription information, contact: McGraw Hill, 29th Floor, 1221 Avenue of the Americas, New York, NY 10020.

- Join on-going discussion groups (electronically) about issues ranging from how to get more money budgeted for ITE, effective public relations ideas and new legislation.

- Exchange information with colleagues, ask questions of them and of experts brought on-line for that purpose, offer opinions and suggestions -- or just be an observer and read what other have entered.

- Participate when it is convenient for you; time and geography are irrelevant to computer conferencing. Go on-long at 3 a.m. or 3 p.m. and leave whenever you like -- there are no schedules to be followed.

- Send and receive mail via computer; electronic mail allows you the same privacy and one-on-one communications you get using the U.S. Postal Service but without the delays!

There are also several excellent sources for public domain and/or shareware software for your computers -- regardless of its brand. The best seem to be the various user groups that are found in most medium and larger-sized towns. One can usually learn about these from a store that handles your particular brand of computer. Through the ITEA's national office, one can also learn about various centers/people who are distributing ITE software.

Accessing Audio-Visual Aids

ITE teachers often find that audio visual aids really help to get the point across. But how does one find out where and what is available?

Teachers are advised to keep scanning the professional magazines, e.g. Industrial Education, The Technology Teacher (ITEA), Vocational Education Journal (AVA) and School Shop. Most of these have special sections listing audio-visual aids. Additionally, the trade (i.e., technical) magazines often list useful aids that can be acquired for little or nothing. Then there also publications like the Educational Media Index, Index to Instructional Media Catalogs, NICSEM Index for special needs materials, the Free and Inexpensive Aids . . . series, and the Educator's Guide . . . series that list useful materials. All are detailed in this chapter's resource section (part 6).

In Missouri, there also exist some centers that have lending libraries of useful films, videotapes and other aids. These include:

- UMC Film Library
  Academic Support Center
  505 East Stewart Road
  University of Missouri-Columbia
  Columbia, MO 65211
  (314) 882-3601

- Modern Talking Picture Service
  86 Weldon Parkway
  St. Louis, MO
  (314) 567-4278

- Vocational Resource Center
  Instructional Materials Laboratory
  Room 8, Industrial Education Building
  University of Missouri-Columbia
  Columbia, MO 65211
  (314) 882-2883 (800) 392-7217

- Media Center
  State Fair Community College
  1900 Clarendon Road
  Sedalia, MO 65301
  (816) 826-7100

Securing Donations and Surplus

Several mechanisms exist whereby the ITE instructor can secure donations or the equivalent. The easiest mechanism, although technically not a donation may be considered as one because of the very low cost charged for items. This is of course the State's surplus outlet in Jefferson City. This agency warehouses and makes accessible a wide variety of machines, tools, equipment and supplies of use to ITE. It is worth a regular trip to see what they have -- no phone call can communicate the variety of possibilities typically found there.

Instructors should contact the agency directly and process the necessary paperwork to document their eligibility. At the same time they should request to be placed on the mailing list for the agency's regular announcements. The agency may be reached at:

Missouri State Agency for Surplus Property
P.O. Drawer 1310
117 Riverside Drive
Jefferson City, MO 65102
(314) 751-3415

The National Association for the Exchange of Industrial Resources (NAEIR) exists just for the purpose of brokering donations of surplus industrial goods to education. This subscription service provides catalogs and distributes materials nationwide. Contact them directly for details of their service:

National Association for the Exchange of Industrial Resources
560 McLure Street
P.O. Box 8076
Galesburg, IL 61402
(309) 343-0704

Of course other associations also exist to help promote industry -- education cooperation. One of these, the well-established National Association for Industry Education (NAIEC) has a record of supporting local/regional industry-education councils. Information about these and other NAIEC services and publications is available from:

National Association for Industry Education Cooperation
235 Hendricks Boulevard
Buffalo, NY 14226
(716) 833-6346

Curriculum Support

In Missouri, the best way to secure up-to-date ITE curriculum information is to contact the state supervisor for industrial arts. Also instructors should contact the state's Vocational Resource Center (MVRC, see Table V-3) and request the help they need. This center does support ITE well. It may also be that the MVRC directs you to the state Instructional Materials Laboratory which produces instructional materials. Missouri's major centers producing and disseminating useful curriculum and media material are:

Instructional Materials Laboratory
908 Woodson-Way
University of Missouri-Columbia
Columbia, MO 65211
Phone: (314) 882-2883
Toll Free: (800) 392-7217

Media Center
State Fair Community College
1900 Clarendon Road
Sedalia, MO 65301
Phone: (816) 826-7011

If materials cannot be found in-state, the MVRC will conduct a nationwide search as appropriate and usually at no charge. ITE instructors interested in activities with which to implement the new thrust towards technology are also encouraged to contact the Center for Implementing Technology Education (at the Department of Industry & Technology, Ball State University, Muncie, Indiana 47306, 317: 285-5659) for a collection of instructional modules that students can use.

Notes:

4. Using Advisory Committees

Advisory committees at the state and local level should help educators determine the nature, content and activities of each course. In addition, they can provide valuable input regarding the facilities required to implement the program. Local committees are helpful in determining community needs and in identifying the human and material resources available from within the community and local industry.[1]

Although it is important to note that such committees are not policy or decision making groups, their services are valuable and should be given every consideration. But finally, it is the responsibility of the ITE instructor and the school's administration to decide whether (and how) the recommendations are to be implemented.

Local advisory committees may be the single most important source of information and assistance available to the ITE teacher. A great deal of assistance can be obtained from these committees themselves. However, in interaction with state and national advisory committees an even broader perspective on programing, industrial needs and available resources is available.

One overall advisory committee should be established for the ITE program. If the school has a vocational or community advisory committee/group/organization, then it is important that a representative from the ITE advisory committee serve on the other advisory group for liaison and coordination purposes. Similarly one ITE advisory council member should be designated to establish a correspondence link with the national Technology Education Advisory Council. Such correspondence should be directed through the ITEA national office. Another member should keep in touch with Missouri's Council on Vocational Education.

National Technology Education Advisory Council

At the National Level, the Technology Education Advisory Council (TEAC) was established to provide information to the technology education profession about current developments and possible trends in technology and industry and about the implications of those trends for technology education. As such the TEAC services to:

- Recommend ways of resolving discrepancies between the programs and philosophies of technology education and current industrial/technological practices.
- Recommend content directions to improve the relevance of technology education.
- Suggest methods of improving the public's perception and understanding of technology education.
- Facilitate the cooperation between industry and education to improve the education of youth.

The TEAC's recommendations are advisory since the council has no official policy-making authority. The council's topics of discussion vary as the association's membership suggests or as requested by the ITEA's Board of Directors -- the TEAC's sponsoring group.

Local ITE Advisory Committees[2]

The duty of local industrial technology education advisory committees is to counsel and advise ITE instructors, supervisors, school administrators and the school board concerning the directions, management and supervision of the ITE program. Generally these committees also assist in the development and maintenance of the ITE curriculum and facility. An excellent guide (Behymer) to the use of advisory committees is available from UMC's Instructional Materials Laboratory.

---

[1] Guidelines for Industrial Arts in Career Education, n.d.

[2] Adapted from Towler, pp. 75-76.

Local advisory committees provide community and industrial input to teachers and counselors. They are not policy- or decision-making groups, rather they advise by reviewing policies and programs, by expressing opinions on programs, services, facilities and learning activities and by identifying trends, priorities and resources. It is recommended that such committees be asked to submit an annual report as well as such special reports as appropriate. It is also important that the advisory committee addresses the ITE program's relationship to the overall school curriculum. Other recommended advisory committee activities include:

- Making recommendations regarding program content and needed curriculum, equipment and facility changes.
- Providing information and technical assistance necessary to update the program.
- Assisting in developing performance objectives
- Assisting in developing and conducting community surveys.
- Providing with information regarding new career opportunities.
- Assisting in obtaining community resources.
- Assisting in the development and promotion of good public relations.
- Assisting in the evaluation and review of the program (Towler, p. 75).

Local ITE Advisory Committee Membership

There is no one answer to the optimum size of an advisory committee. Each committee should be comprised of members representative of the community it serves. Normally however, about seven members (less in small communities) will provide adequate coverage of geography, minorities and industries within a given community. The following should provide helpful guidelines for selecting committee members.

- Industry representatives, e.g.:
  - One individual from the communications industry.
  - One from energy/power.
  - One from materials processing industry
- One ITE educator
- One or more parents (can be identified by the local PTA)
- One or two students (at least one should be female)
- One representative from the school or system's administration
- One individual representing vocational education
- One specialist in the area of special needs populations

Some method of membership rotation should be devised prior to the actual formation of a committee. Fresh viewpoints and ideas are essential to properly address our rapidly changing technological world. For this reason, only under exceptional circumstances should the reappointment of a committee member be considered. One workable way to address the rotation of committee members is to make their initial terms of varying length -- typically one, two and three years are used.

Advisory committees could of course use consultants, on a temporary basis, to assist in solving specific problems. Specialists in areas outside of the committee's areas of expertise can serve on a temporary basis until a specific problem or concern is adequately addressed. If this arrangement is used the consultants would not have voting privileges in committee matters. Their services would be on a strictly consulting basis.

Local ITE Advisory Committee Operations

Selection of Officers. Each advisory committee should elect a chair and a secretary. It is recommended that a teacher or administrator not serve as chair, but may serve as secretary.

Officer duties.

The chair:

- Shall call and preside at all committee meetings.
- Shall schedule all meetings and make necessary committee assignments.
- Should prepare and agenda for each meeting.

The secretary:

- Will record, maintain and distribute minutes of every meeting to each member of the committee.
- Is responsible for notifying members of the meeting date, time and place.
- Should provide all members with an agenda and issues to come before the committee prior to the meeting, preferably one week in advance.

Meetings. It is recommended that:

- The initial meeting be held within thirty days following appointment of the committee. The superintendent, or a representative, should call this meeting and preside until a chair is selected.
- The committee members be acquainted with the purpose and duties of the committee.
- Committee meetings be planned for specific purposes. Behymer's guide provides an excellent outline for a program of work.
- Regular scheduling of meetings be determined by membership, based on existing problems and important matters for consideration.
- The committee should establish its own governance rules.

The School's Responsibility to Committee Members. Committee members should be informed, by an official letter from the superintendent of schools, that membership is an official act which has state approval. The committee and school administrators should work in harmony to serve a definite purpose. Committee members must be advised that they are resource persons to improve curricula, facilities, teacher preparation, occupational information, community surveys and public relations. (Towler, p. 76)

Notes:

Managing Student Performance Records

Industrial Technology Educators have a large responsibility in tracking and recording student progress. The results of homework, projects, activity observations, exercises and tests all have to be recorded. Fortunately standard record books exist for such things. They can be purchased at any large school supply store. Increasingly common are computer-based approaches for such management tasks. Usually these are called instructional management systems. The Missouri Vocational Administration Management System (VAMS) is an example often found at Area Vocational Schools.

ITE instructors often build their own management systems. Computer data base and/or spreadsheets programs are most often used for this. Visi-calc™, Lotus™, Excel™ and Appleworks™ are some of the most frequently used programs but many others can be used as well. Nor does the brand of computer really matter--all can help.

A side benefit of computerized approaches is the ease with which reports and summaries can be prepared. This helps teachers increase the amount of feedback to students and parents -- and it does so without significantly adding to the instructor's work load. Yet another benefit is that all such records are typically in one place -- no chasing after various and sundry records is needed.

There is however, a responsibility for the security of records that the instructor must assume. Given the capabilities and interests of today's students, each ITE instructor using a computerized record keeping system must install some procedure for guarding the integrity of these records. Locking the disks in a secure place is one inexpensive yet effective way to accomplish this.

Managing Field Trips

Instructors cannot assume that field trips are "just another teaching method." Because such trips typically expose students to hazards they would not encounter at school, boards of education often establish specific policies for such trips. Typically these policies involve securing parental permission, meeting insurance requirements and controlling the means of transportation. ITE instructors must be sure to follow these local policies in detail in order to qualify for insurance coverage, minimize liability and risk to students.

On the field trip, instructors should take with them a list of student names and emergency contacts. Then they must also exercise careful control over the class for the entire duration of the excursion. It is always recommended that the trip begin and end at school; do not allow students off at various points along the way.

Inventorying Equipment and Tools

Essentially ITE instructors are responsible for the equipment and tools in their laboratories. To properly account for the public's investment in ITE, it is recommended procedure to inventory the facility at the start and end of each school year. Such a form, a sample of which is shown in Figure V-1, should include as a minimum the following information.

- School name
- Laboratory name
- Item name
- Item description
- Inventory number
- Date inventoried
- Condition code
- Signature of person verifying inventory

School: ______________________ **Laboratory:** ______________________ **Page** __ **of** __

				Inventory							
				School Start: __/__ By: ________		School End: __/__ By: ________		School Start: __/__ By: ________		School End: __/__ By: ________	
Item Name	**Description**	**Value**	**Inventory No.**	Date	Condition*	Date	Condition*	Date	Condition*	Date	Condition*

* Condition Code: E = Excellent, A = Average, P = Poor, M = Missing, X = Needs Replacement

Figure V-1 ITE Inventory Form

Managing Supplies

The management of supplies presents ITE instructors with more challenge than equipment does. Typically there is a greater number of supplies which have to be tracked. Furthermore, many supply items are sold and/or consumed by students. Additionally some items have shelf-lives that need to be considered.

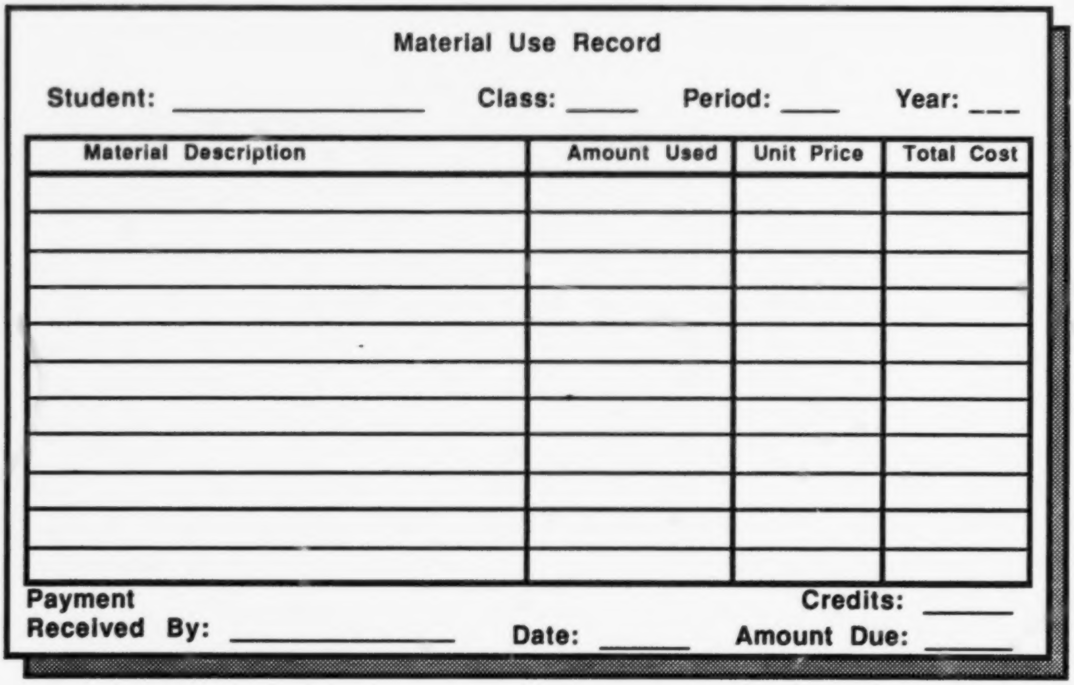
To address this challenge, it is recommended that instructors keep a materials card for each student. On this card, either the student or instructor records the materials used (or issued) each time. Then, at the end of each period or term it is relatively easy to charge the appropriate amount. Figure V-2 shows a form that can help document material usage.

The maintenance of a supply inventory is facilitated if the instructor develops a list of what items should be at hand. Then he/she should augment this with quantity points, which when reached, trigger a resupply order. All that remains then is to conduct a monthly or bimonthly inventory of the supplies on hand to see of these points have been reached or exceeded. Figure V-3 shows a form that can help track a supply inventory.

Finally, because of the multitude of small supplies needed to keep the typical program operating, it is recommended that ITE instructors each be allocated a small revolving cash fund. This should be used for incidental local purchases. At the end of the year an accounting of this money should be made to the principal or department chairman.

Figure V-2

Material Use Record



Material Use Record

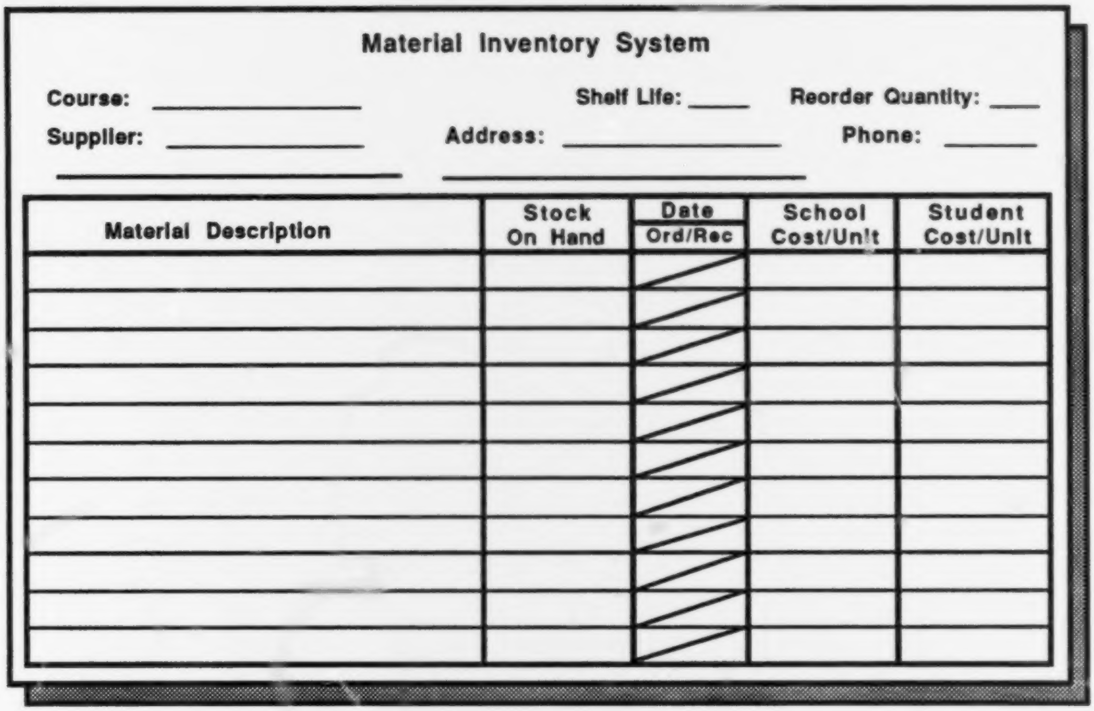
Student: ________________ Class: _____ Period: ____ Year: ___

Material Description	Amount Used	Unit Price	Total Cost

Payment Received By: ________________ Date: ______ Credits: ______ Amount Due: ______

Figure V-3

Material Inventory System



Material Inventory System

Course: ________________ **Shelf Life:** ____ **Reorder Quantity:** ____

Supplier: ________________ **Address:** ________________ **Phone:** _______

_________________________ _________________________

Material Description	Stock On Hand	Date Ord/Rec	School Cost/Unit	Student Cost/Unit

6. Resources

________. A Curriculum Resource for Technology Education. Worcester, MA: Davis Publications, Inc., n.d.

________. Computer Programs in Industrial Arts/Industrial Technology Education. South Holland, IL: Goodheart-Wilcox, 1984.

________. Directory of Colleges & Universities Offering Degrees in Technology Education/Industrial Arts. Reston, VA: International Technology Education Association, 1986.

________. Directory of Curriculum Guides and Other Key Resources. Reston, VA: International Technology Education Association, 1985.

________. Educational Media Index. Volume 9. Industrial and Agricultural Education. New York: McGraw-Hill, 1964.

________. Educator's Grade Guide to Free Teaching Aids. Randolph, WI: Educator's Progress Service, Annually.

________. Educator's Guide to Free Audio and Video Materials. Randolph, WI: Educator's Progress Service, Annually.

________. Educator's Guide to Free Films. Randolph, WI: Educator's Progress Service, Annually.

________. Educator's Guide to Free Filmstrips. Randolph, WI: Educator's Progress Service, Annually.

________. Educator's Guide to Free Science Materials. Randolph, WI: Educator's Progress Service, Annually.

________. Encyclopedia of Associations. Detroit, MI: Gale Research Company, 1985.

________. Guide to Free Computer Materials. Randolph, WI: Educator's Progress Service, 1983.

________. Guidelines for Industrial Arts in Career Education. Pittsburgh, PA: University of Pittsburgh, n.d.

________. Handbook for Advisory Council Members. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, n.d.

________. Handbook for Industrial Arts Education. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, 1977, [IA-2-1].

________. Index to Instructional Media Catalogs. New York: Bowker, 1974.

________. Index to Media and Materials for the Visually Handicapped, Orthopedically Impaired, and Other Health Impaired. Los Angeles, CA: National Information Center for Special Education Materials, 1978.

________. Industrial Technology Systems Handbook for Industrial Arts/Technology Education. Columbus, OH: The Ohio State University/Ohio Industrial Arts Association, 1985.

________. Iowa Industrial Arts Handbook for Selected Aspects of Organization and Administration. Des Moines, IA: Iowa Department of Public Instruction, n.d.

________. Quality Features for Industrial Education Programs: A Guide Designed to Enhance and Support the Illinois Plan. No. 278a. Macomb, IL: Illinois State Board of Education, n.d.

________. Resource Directory of Curriculum Centers/Labs. Stillwater, OK: Vocational Instructional Materials Section (AVA) and National Network for Curriculum Coordination in Vocational Technical Education, Revised, June 1985.

________. Using the Computer in Industry. Dekalb, IL: Northern Illinois University, n.d.

Barnes, James L. Systems of Technology: Organization and Management of Instruction Handbook. Austin, TX: University of Texas-Austin, Center for Occupational Curriculum Development, 1984.

Behymer, Jo. Handbook for Instructors Involving Vocational Advisory Groups in Program Improvement. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, 1985 [VE-49-1].

Darrow, Don & Pine, Douglas. Iowa Industrial Arts Handbook. Des Moines, IA: Iowa Department of Public Instruction, 1980.

Dennis, Ervin A. (Compiler). Industrial Teacher Education Directory. Cedar Falls, IA: Council on Technology Teacher Education/National Association of Industrial and Technical Teacher Educators, Annually.

Dyrenfurth, Michael J. & Linhart, Richard E. Vocational Safety Guide. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, 1981.

Moore, Norman R. Free and Inexpensive Learning Materials. Nashville, TN: George Peabody College for Teachers/Incentive Publications, 1979.

Pepe, Thomas J. Free and Inexpensive Educational Aids. New York: Dover Publications, 1970.

Saterstrom, Mary H. Educator's Guide to Free Guidance Materials. Randolph, WI: Educator's Progress Service, Annually.

Towler, Alan L. The Industrial Arts Guide. Austin, TX: Center for Occupational Curriculum Development, The University of Texas-Austin, n.d.

Chapter VI

Evaluating Industrial Technology Education

1. Introduction

This chapter highlights the three main evaluations ITE instructors deal with on a regular matter. As professionals, they need to be concerned with: Evaluation of the ITE program, evaluation of student performance and evaluation of the ITE instructor him/herself. Important guidelines for each of these three types of evaluations are described in the following sections.

Notes:

2. Evaluating the ITE Program

Overview

There are basically three types of evaluations an ITE program can undergo: local (internal) evaluation, school accreditation and state evaluation. Each evaluation serves a different purpose but all focus on program improvement.

Local (Internal) Evaluation. These evaluations focus on the improvement of instruction and are conducted by school personnel. Such "in house" evaluations are often conducted on a yearly basis. This type of evaluation should not be informal and incidental, but rather formal in nature. In other words the process should be conducted on a formalized, scheduled and official basis with the results recorded for the board of education's review. These internal program reviews allow school personnel to make adjustments to programming, facilities and equipment, often with the guidance of the ITE advisory committee. The Missouri ITE Standards provided in Chapter VIII's part 3 are an excellent basic framework for this kind of evaluation.

School Accreditation. Missouri schools may elect to pursue external and/or state accreditation. The North Central Association of Schools and Colleges (NCA) provides the mechanism for external accreditation. The accreditation process is voluntary and thus is quite flexible in permitting local procedures to vary considerably. However the basic elements and sequences are typically similar. They involve:

1. A request for accreditation to NCA

2. Conduct of a self-study that involves:

   - Formation of a local committee
   - Self-evaluation of each program (ITE is one)
   - Self-evaluation of school- and community-wide functions
   - Compilation of appropriate documentation

3. Establishment of a visiting team

4. Visiting team review of self-study as prepared by the school's local team

5. Visiting team on-site visit including:

   - Program by program review
   - Overall function review
   - Validation of documentation
   - Exit report

6. Visiting team report of findings

7. Visiting team leader and local committee interaction establishing required follow-up

8. One year follow-up of required action

Basically it is important for ITE instructors to consider such accreditation procedures as an opportunity -- not a threat. To facilitate this it is strongly encouraged that the local ITE instructors nominate two or three highly respected industrial technology educators to serve on the visiting team. Don't just select friends or colleagues who you think would be "easy" on the program. Often such accreditation reports provide just the kind of support that secures long-needed improvements.

The NCA does not mandate any given set of evaluation instruments. Instead it encourages local institutions to use standards of "appropriate professional organizations." To ease matters however, the NCA provides a set of evaluation criteria that are produced by the National Study of School Evaluation (NSSE). A sample page from the latest version of their Technology Education (Industrial Arts) criteria is provided in Figure VI-1. Because of the national approval process used, such criteria lag somewhat behind the profession's pulse so these criteria do not necessarily represent the profession's most current thinking. Therefore it is recommended that for accreditation purposes, local schools update the NSSE criteria with the Missouri ITE Standards provided in Chapter VIII's part 3. A combination of these two would make for an exceptionally strong self-evaluation.

State (DESE) Evaluation. Missouri's Department of Elementary and Secondary Education recommends that all ITE programs be evaluated periodically. For programs receiving special state and/or federal funding, such evaluations typically need to be conducted at least once every five years.

As with accreditation procedures, it is recommended that state evaluations begin with a systematic self-evaluation. To help in this, Missouri DESE's industrial arts section provides a set of standards and evaluation criteria.[1] These are based on an instrument prepared by the American Industrial Arts Association's (now ITEA) Accreditation and Evaluation Committee and subsequently endorsed by the Industrial Arts Association of Missouri (now MITEA) and the Industrial Arts Division of the Missouri Vocational Association. This instrument, a sample of which is provided in Figure VI-2, includes administration, instruction and recommendations sections. State evaluation also involves a visiting team's on-site evaluation. As with accreditation assessment, it is strongly recommended that ITE instructors present a fair and complete picture of their program's strengths and weaknesses.

---

[1] With the development of the Missouri Industrial Technology Education Standards, provided in part 3 of Chapter VIII, it is recommended that these be used to replace the older AIAA evaluation standards.

Figure VI-1

Evaluative Criteria from the National Study of School Evaluation: Technology Education (Industrial Arts), 6th Edition[1] (sample page)

Section 4-16 Technology Education (Industrial Arts).

• • •

4. Teachers plan and provide for evaluating the effectiveness of their instruction. 5 4 3 2 1 n/a

5. Alternatives and appropriate methods to assist students in meeting course objectives are provided by teachers. 5 4 3 2 1 n/a

6. Students develop an insight and understanding of the technological society as a result of activities in courses. 5 4 3 2 1 n/a

7. Emphasis is placed upon improving student ability to make informed and meaningful career choices. 5 4 3 2 1 n/a

8. Technology education prepares students for collegiate and/or advanced vocational/technical programs and equips them with universally transferable technological skills. 5 4 3 2 1 n/a

9. Emphasis is placed upon preparing students for life-long learning in a technological society. 5 4 3 2 1 n/a

10. Instructional activities develop student skills, positive self-concepts and individual potentials in technology. 5 4 3 2 1 n/a

11. Instructional activities are designed to teach the application of tools, materials, machines, processes and technical concepts safely and efficiently. 5 4 3 2 1 n/a

12. Instructional activities promote the development of process skills such as creative and critical thinking, decision making and problem solving. 5 4 3 2 1 n/a

13. Both teacher-centered and student-oriented instructional methods are utilized. 5 4 3 2 1 n/a

• • •

Rating Scale

5 = Excellent
4 = Good
3 = Fair
2 = Poor
1 = Missing but needed
N/A = Not Applicable

---

[1] The complete evaluation instrument for Technology Education (Industrial Arts) may be secured from Dr. Robert C. Shaw, 218 Hill Hall, University of Missouri-Columbia, Columbia, MO 65211 or Missouri's Industrial Technology Education Supervisor.

Figure VI-2

Standards and Evaluation Criteria for Industrial Arts Programs[1,2] (Public & Private 7-12) from Missouri Department of Elementary and Secondary Education (Sample Page)

Standard I.	Curricular goals are established that provide inspiration and guidance in program development, operation and evaluation.	
Criterion 1.	Curriculum goals are written and on file in appropriate administrative offices.	5 4 3 2 1 n/a
Criterion 2.	Curriculum goals are used by teachers in planning and reviewing courses.	5 4 3 2 1 n/a
Criterion 3.	Curriculum goals are reviewed periodically for consistency with state and national standards and trends.	5 4 3 2 1 n/a
Criterion 4.	A written rationale for the curricular offerings exists for each course, each level of instruction, and for the complete program.	5 4 3 2 1 n/a
Criterion 5.	Courses of study are prepared and on file for all courses:	5 4 3 2 1 n/a
	5.1 Course objectives are stated in measurable terms.	5 4 3 2 1 n/a
	5.2 Course objectives and instructional methods are consistent with rationale and curriculum goals.	5 4 3 2 1 n/a
Standard II.	Subject matter content is appropriate to learner's level and consistent with curriculum, course goals and objectives.	
Criterion 1.	Technical content is sufficiently broad to provide exploratory experiences in all the major technology clusters.	5 4 3 2 1 n/a
Criterion 2.	The industrial arts program consists of a balanced and articulated curriculum for grades 7-12 with broad exploratory technology cluster areas for grades 7-9 followed by in-depth exploration for grades 10-12.	5 4 3 2 1 n/a
Criterion 3.	Each course provides for learning experiences in:	
	3.1 Industrial management practices.	5 4 3 2 1 n/a
	3.2 Industrial tools and materials.	5 4 3 2 1 n/a

•••

---

[1] A complete instrument may be secured from Missouri's State Industrial Technology Education Supervisor.

[2] With the development of the Missouri Industrial Technology Education Standards (provided in Chapter VIII's part 3), it is recommended that these be used to replace the older AIAA evaluation standards.

Local Evaluation

In the Missouri Vocational Program Evaluation Project's Administrator's Handbook, Chapter III outlines a detailed procedure that will be effective for the overall local evaluation of a school. The recommended procedure shown in Figure VI-3 is adapted from this project's model. The local program evaluation committee -- a central feature of this procedure is recommended to include people such as:

- The ITE Advisory Committee chair-person or representative
- Recent program alumni
- ITE program teacher/administrators
- Outside experts
- Parents and community representatives
- State department supervisor or designee

The evaluation system is based upon the collection and interpretation of data from three sources: Data in reports to the Department of Elementary and Secondary Education, local documentation and specific evaluation instruments. Synthesis of information from all of these sources will provide an accurate picture of the quality of the program at the local level.

It is expected that the teams and individuals involved will meet as necessary to effect a thorough evaluation. A time span of 30 to 90 days is recommended for Activities 1 through 9. Throughout the evaluation it will be necessary for the participants (i.e., the local evaluation team, the team's chair-person and the school's administration) to keep each other informed as to their activity. Also important is that access, by all involved parties, to relevant information is made easy.

Activity 1: Establish Evaluation Team

The school's principal or superintendent should appoint the local evaluation team. It is this team's responsibility to identify all factors to be evaluated, to collect appropriate data, to assemble the relevant documents and to develop and present the evaluation report to the administration. The team is advised to keep minutes of their regular meetings and to keep key people informed.

Note that tailoring of team membership is encouraged. The team should be deliberately formulated to result in a comprehensive evaluation.

Activity 2: Initial Planning Meeting

Conduct a preliminary planning and briefing meeting with the entire evaluation team and the school's superintendent or principal. At this meeting the chair-person clarifies any procedural concerns, provides technical advice when necessary, establishes timelines and assigns individual responsibilities.

Activities 3, 4, 5, & 6: Data Collection

These steps involve collection of data necessary to complete the evaluation picture by the local evaluation team. The plans and procedures for such activity would involve procedures approved at the preliminary planning meeting (Activity 2) or at subsequent meetings. Included are:

- Consolidation of data from reports to Missouri's Department of Elementary and Secondary Education.

- Review of the institution's files for information of relevance to the evaluation of the ITE programs. Included in such reviews would be:

  - The most recent North Central Association accreditation report
  - Evaluative reports filed by DESE and Vocational Education personnel

- Institution classification documents
- Institution and/or program advisory council reports
- Previous self-evaluations
- Official budgets and records of expenditures
- Follow-up evaluations
- Institution and/or board policy handbooks

- Analysis and synthesis of information contained in such documents to form the supportive rationale for the local evaluation.

- Synthesis and analysis of information obtained from the use of any specific instruments and procedures required to fill information gaps identified in Activities 4 and 5.

Activity 7: Development of Evaluation Report

At this stage, the local evaluation team pulls together the information obtained through activities 3, 4, 5 and 6. The team then weighs the evidence and develops a final written evaluative report. Figure VI-4 outlines a tentative format.

Activity 8: Submitting Evaluation Report

The local evaluation team prepares copies of their report and submits them to the school's administrators. Together they then schedule a time for formal presentation of the evaluation's findings.

Activity 9: Administrative Review of Report

The school's administration now evaluates the report and its findings as well as any clarifications pursued at the formal presentation.

Activity 10: Supplying Additional Information

Administration requests additional information and/or explanations as needed.

Activity 11: Developing Program Improvement Plan

The local evaluation committee, together with the ITE program's teachers and supervisors, then plan and detail the program improvement needed. Objectives, plans, equipment acquisitions and needed renovations should all be incorporated as well as any other items that the evaluation called for.

Activity 12: Securing Technical Assistance

The school's administration and Missouri DESE's Industrial Arts section and other appropriate individuals supply the technical assistance necessary to implement the program improvement plan.

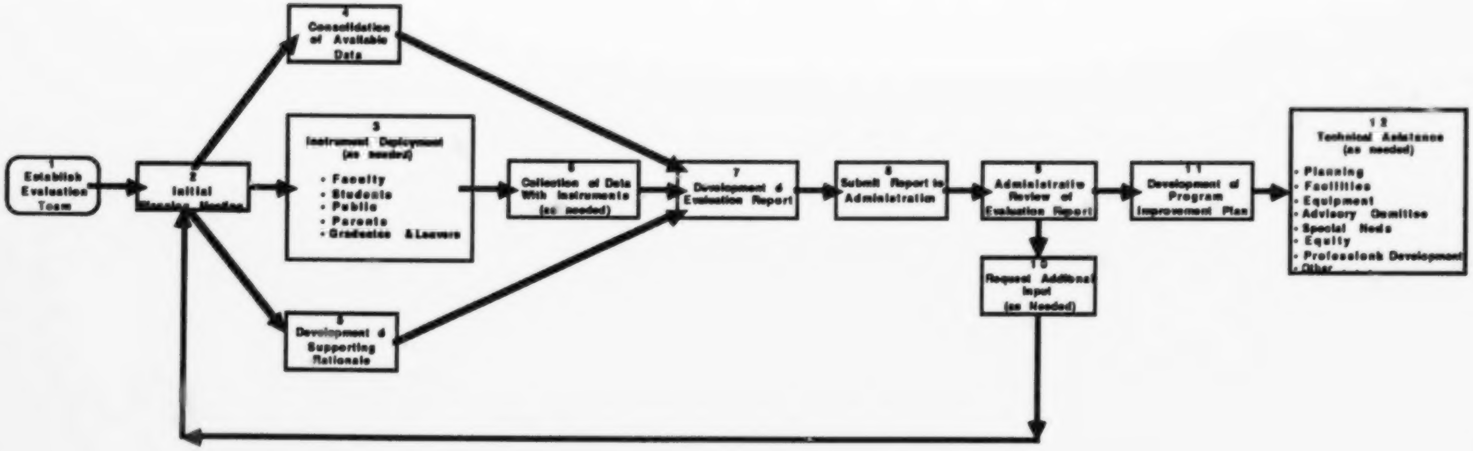

1
Establish
Evaluation
Team
2
Initial
Planning Meeting
4
Consolidation
of Available
Data
3
Instrument Deployment
(as needed)
• Faculty
• Students
• Public
• Parents
• Graduates & Leavers
5
Development of
Supporting
Rationale
6
Collection of Data
With Instruments
(as needed)
7
Development of
Evaluation Report
8
Submit Report to
Administration
9
Administrative
Review of
Evaluation Report
10
Request Additional
Input
(as Needed)
11
Development of
Program
Improvement Plan
12
Technical Assistance
(as needed)
• Planning
• Facilities
• Equipment
• Advisory Comittee
• Special Neds
• Equity
• Professional Development
• Other

Figure VI-3 Local Evaluation System Procedures[1]

---

[1] Adapted from Elias & Dyrenfurth, 1980

Figure VI-4

Suggested Local ITE Evaluation Report Format[1]

1. Title page
2. Table of contents
3. Brief narrative description of the institution and its setting
4. Evaluation team
   - Team composition
   - Key minutes
5. Local procedures employed
   - Instruments
   - Populations surveyed
   - Schedule of activities
6. Quantitative data summary
   - Locally collected
   - Longitudinal reports
7. Supportive statements for each major evaluative area
   - Needs assessments
   - Inputs
     - statements of goals and objectives
     - program of work
     - resources allocated
   - Process characteristics
   - Key outputs
8. Findings and conclusions
   - Strengths
   - Weaknesses
     - mitigating factors
     - recommended strategies for addressing weaknesses
     - requests for technical assistance
9. Appendices
   - Samples of each instrument used
   - Titles and locations of supportive documents available at the school

---

[1] Adapted from Elias & Dyrenfurth, 1980.

Keying to State Goals and Competencies

One of the strongest arguments to be made for the ITE program is its contributions to the educational goals for the state of Missouri and the core competencies that define them. The latest versions of the complete texts of these are available from Missouri Department of Elementary and Secondary Education.[1] Given the importance of these goals and competencies, it is also important that the ITE's evaluation documents the link between ITE participation and the achievement of Missouri's education goals and core competencies. Therefore industrial technology educators would be well advised to build into their evaluation questions and methods that secure data to show how their program contributes to the mastery of core competencies by advancing their students':

- Intellectual Development in the areas of:
    - Communication
    - Quantitative thinking
    - Social processes
    - Scientific understanding
    - Decision making
    - Aesthetic sensitivity
- Physical Development in the areas of:
    - Growth and motivation
    - Health
    - Recreation
- Social Development in the areas of:
    - Social and physical environment
    - Cultural awareness
    - Governmental institutions and citizenship
    - Avocational pursuits
    - Concept of self, morality and values
- Career Development in the areas of:
    - Social significance of work
    - Occupational exploration
    - Occupational preparation
    - Occupational education (adult training and/or retraining)

Follow-up Evaluations

As part of any of the types of evaluations (local, accreditation, state) a follow-up of students can provide many useful insights. Therefore it is recommended that each ITE program conduct and maintain careful records of a follow-up of its students. Such a study should record:

- Data descriptive of the students flowing through the program, e.g., age, sex, GPA, socio-economic class, aspirations, educational plans, test scores and the like.
- Data showing what kind of educational experience students had after participating in the ITE program.

---

[1] Missouri Department of Elementary and Secondary Education, P.O. Box 480, Jefferson City, MO 65102

- Data showing what kind of work experiences they had during and after participating in the ITE program.

- Similar data for comparable students without ITE program experiences.

To conduct follow-up evaluations, the ITE instructor typically tracks students who have participated in ITE -- for several years after they have done so. Typical follow-up intervals are 1 year, 3 year and 5 years after ITE. In order for such evaluations to succeed the school must keep careful enrollment and address records both while the students are in school and for at least 5 years after they graduate or leave.

Typically, because of costs and the work involved, one samples the students who have taken ITE rather than surveying all of them. The actual survey method could be:

- Telephone interview
- Mail survey
- In-person interview (at home)

The following represents some typical questions that may be posed in various ways in a follow-up survey. Figure VI-5 shows a sample layout of such an instrument.

- What do ITE students think of the program? Did students enjoy ITE?

- How useful was the ITE program in developing career and technology awareness?

- Did ITE enhance their understanding of science and technology?

- What courses were taken after ITE?

- How useful was ITE in securing a job?

- Was ITE helpful in identifying and preparing for advanced vocational-technical education?

- Did ITE help them with consumer decisions?

Figure VI-5

Program Follow-up Form[1]

My date of program completion or graduation was: ____________________

The ITE Course(s) that I participated in was (were): ____________________

Please complete each item, using the 7-point rating scale. Choose the number that most closely reflects your opinion and write it in the box to the right of the item, as in the following example:

	Vitamin C is:	very beneficial	1 2 3 4 5 6 7	not at all beneficial

(Note: A rating of 3 indicates that vitamin C is thought to be only a little beneficial.)

1.	My experience in ITE was:	very satisfying	1 2 3 4 5 6 7	not at all satisfying
2.	If I could choose courses again I would:	choose ITE courses	1 2 3 4 5 6 7	not choose ITE courses
3.	My occupational/educational plans for the future are to:	enter (or stay in) an area of ITE	1 2 3 4 5 6 7	not enter (or stay in) an area of ITE

Questions 4-6 are similar but they are not identical. Please be sure to answer all three questions.

4. Which of the following best describes your present situation?
    1. employed full-time (35 hours or more per week)
    2. unemployed, or employed part-time, but seeking full-time employment
    3. full-time student
    4. none of the above

5. Which of the following best describes your present situation?
    1. employed full-time in an area of industrial technology.
    2. unemployed, or employed full-time or part-time, but seeking full-time employment in an area of industrial technology
    3. full-time student
    4. none of the above

6. Which of the following best describes your present situation?
    1. employed full-time in an area of industrial technology
    2. employed full-time in an area related to industrial technology
    3. employed full-time in an area unrelated to industrial technology
    4. employed full-time or part-time, but seeking employment in industrial technology
    5. unemployed, but seeking employment in industrial technology
    6. full-time student
    7. none of the above

---

[1] Adapted from Pautler, 1977, p. 8-9.

Missouri School Classification and Accreditation[1]

The basic objective of the classification and accreditation program is to recognize educational resources and provide direction and assistance in the development of quality programs in the public schools (p. 2).

The minimum educational program recognized for classification is described as "Class AA." To encourage local school systems to provide more than the minimum program, the "Class AAA" program is described. There are no financial inducements for meeting classification standards. The desire to better serve student needs is the primary incentive. School districts which do not attain all of the goals or standards for one of the classifications (AAA or AA) will be advised....

Essentially schools are classified by the extent they meet a set of standards established by the state. These standards, not to be confused with the ITE standards, are printed in Missouri DESE's Handbook for Classification . . . . which includes sections on:

I. Standards to be met by all classified and accredited school districts

1. Philosophy, goals and objectives
2. Policies of the board of education
3. Administration
4. Budget and financial accounting
5. Salary schedule/program
6. Records and reports
7. Certificates and transcripts
8. Health certificates
9. Secretarial personnel
10. School health services
11. School food services
12. Transportation services
13. School sites, buildings and custodial services
14. School term and school day
15. Instruction time
16. High school credit
17. High school graduation requirements
18. Special subjects
19. Student activities
20. Area Vocational Schools & Special Districts
21. Evaluation
22. In-service Education
23. Basic Essential Skills Test (BEST)
24. Special Education

II. Standards to be met by classified and accredited middle/junior high schools (only the ones most relevant to ITE have been selected)

2. Requirements for Teachers, Supervisors and Teacher Aides

For Class AAA, teachers in departmentalized grades and all supervisors shall have a minimum of a baccalaureate degree with special preparation and certification in the subjects or fields in which they teach . . . . Twenty-five percent (10% for class AA) of the teachers and supervisors shall have completed Master's degrees or 30 semester hours of graduate credit . . . .

Supervisors and subject matter specialists who spend one-half time or more consulting, supervising, or directing teachers in an instructional area shall be certificated in the subject matter area and hold a master's degree with a major in the area (not for class AA).

3. Requirements for Classroom Learning Resources, Libraries and/or School Media Centers and Media Personnel

For Class AAA and AA, adequate and appropriate classroom learning resources shall be provided to enable the instructional staff to effectively meet the individual needs of the students. Each classroom or instructional area shall be arranged and equipped to serve the unique instructional program for which it is utilized. The district should ensure that each student has adequate textbooks . . . .

---

[1] All content in this section cited from MODESE's Handbook for Classification....

4. Teaching Load

For class AAA all teachers shall have planning time scheduled within the school day and shall devote no more than an average of 310 minutes in the six-hour school day to teaching and study halls; except that full-time librarians, guidance counselor and vocational teachers teaching three-hour blocks may devote 360 minutes of the six hour day to these duties. Individual classroom enrollments shall not exceed 35, nor shall the daily load of any teacher exceed 180 students . . .

Teacher aides should be provided to relieve teachers of nonprofessional tasks in order to improve the quality of instruction. Aides should be provided in addition to the standards for professional personnel.

For class AA the requirements are the same as class AAA, except individual classroom enrollments may be 5 more and daily loads 20 more than AAA standards. . . .

6. Curriculum

For Class AAA, the curriculum shall provide learning experiences that will permit every student opportunities for: obtaining basic information; refinement and perfection of basic skills; clarification and assimilation of democratic attitudes and values; and preparation for the next sequential phase of his/her growth and development. The curriculum shall provide the educational environment that will enable a student to explore career opportunities. See Figure 6 in next section for details.

Language arts, social studies, science and mathematics shall be taught to all students a minimum of 800 minutes per week with a minimum of 150 minutes per week to be spent teaching each of these four areas. Exceptions should be made to meet the needs of the 9th grade students. Social studies and language arts classes (and other classes) may be scheduled as a "block."

Both art and music shall be available to all students for at least two periods per week. Physical education shall be taught to all students for at least two periods per week. Home economics and industrial arts shall be available to all students in grades 7, 8 and 9 at least two periods per week each year.[1] Foreign languages, speech and other appropriate courses should be available to all students.

Clubs and co-curricular activities growing out of the learning activities of the school should be encouraged and sponsored by school personnel.

Class AA's requirements are the same as Class AAA's except Home Economics and Industrial Arts are recommended, but not required, for grades 7 and 8.

III. Standards To Be Met By All Classified and Accredited High Schools (Only the ones most relevant to ITE have been selected)

2. Requirements for High School Teachers, Supervisors and Teacher Aides

For Class AAA, all teachers and supervisors shall have as a minimum a baccalaureate degree* with special preparation and certification in the subjects or fields in which they teach. Twenty-five (10% for AA) percent of the teachers and supervisors shall have completed a master's degree or 30 semester hours of graduate credit with a major in an appropriate subject matter area . . . .

*Teachers having experience and proficiency in vocational trade and industrial skills may be certificated under the standards and policies of the Division of Vocational Education.

---

[1] A different time arrangement may be used as long as an equivalent amount of time is provided.

Supervisors and subject matter specialists who spend one-half time or more consulting, supervising, or directing teachers in an instructional area shall be certificated in the subject matter area and hold a master's degree (not for AA) with a major in the area.

3. Requirements for Classroom Learning Resources, Libraries and/or School Media Centers and Media Personnel

Same as JHS requirements previously listed.

4. Teaching Load

Same as JHS requirements previously listed except of the following. Individual classroom enrollments shall not exceed 35, nor shall the daily load of any teacher exceed 180 students, except as indicated below:

- In a cooperative teaching project, such as team teaching, an individual teacher may instruct over 35 part of the time, but the teacher-pupil ratio shall not exceed one to 30 for the project.
- If advanced classes with small enrollments are combined (example: Art III and Art IV) the combined enrollments shall not exceed 20 students.

Teacher aides should be provided to relieve teachers of nonprofessional tasks in order to improve the quality of instruction. Aides should be provided in addition to the standards for professional personnel.

For Class AA the requirements are the same as Class AAA, except individual classroom enrollments may be 5 more and daily loads 20 more than AAA standards.

5. Pupil Personnel Services.

For Class AAA the high school shall provide pupil personnel services based on the needs of the students. The high school shall employ certificated guidance counselors to provide one clock hour of counseling time per day for each 65 students. (A full-time counselor may serve 390 students.) One-half (50%) of the number of special education and vocational technical school students being served by counselors funded with special funds will not be included in the total student enrollment in determining the number of counselors needed . . . The high school shall provide a comprehensive standardized testing program using both aptitude and achievement tests. The minimum program shall be that recommended under the "Statewide Testing Program," or its equivalent.

For Class AA, the requirements are the same as class AAA, except certificated guidance counselors shall be employed for each high school to provide one clock hour of counseling time per day for each 80 students (a full-time counselor may serve 480 students).

6. Curriculum

For class AAA schools, "the curriculum shall provide opportunities for educational experiences which will enable each student to develop rational procedures for being a contributing member of our complex society. It shall foster an educational climate that will prepare him/her to utilize basic skills in pursuit of a career and lifelong continuation of learning. It shall stimulate the development of moral convictions and value competencies."

Each high school shall have a current minimum offering of 60 1/2 units of credit with sufficient sections in each field available to meet the educational needs of all students in grades 9-12 distributed as shown in Figure VI-6. For Class AA the requirements are the same as Class AAA, except each high school shall have a current minimum offering of 40 1/2 units of credit with sufficient sections in each field available to meet the educational needs of all students in grades 9-12, distributed as shown.

Figure VI-6

Basic Curriculum Requirements for Missouri Classification[1]

	AAA	AA
Language Arts/Communication Skills	7	5
Foreign Language	7	2
Social Studies	5	4
Mathematics	4	3
Science (Including physical or earth science, biology, chemistry and physics)	4	3
Fine Arts (Including both and only art and music)***	4	2
Practical Arts/Vocational Education****	5	3
Business and Office Education	5	3
Home Economics	3	3
Vocational Agriculture	3	3
Industrial Arts	3	3
Trades & Industrial, Technical,, Health Occupations and COE/DE	12	4
Physical Education	2	2
Health 1/2	1/2	
Electives	5	3
	60 1/2	40 1/2

* In three year high schools (grades 10-12) the curricular offering at grade 9 may be added to the offering in grades 10 to 12 to meet the curriculum specifications.

** AA schools may request approval to offer two additional electives in lieu of two units of foreign language.

*** Requirements may be met by fractional unit courses, may be taken for more than one year.

**** The requirements for vocational courses may be met by providing the opportunity for all interested students to attend neighboring districts or area vocational schools with the sending district paying tuition and transportation costs thereto. Vocational agriculture offering may be waived in certain districts when it can be established that sufficient need does not exist in the field and the district increases industrial arts, trades and industrial, technical and distributive educational offerings by a total of three units. AA high schools may request approval to offer four units of vocational agriculture and two additional units of trades & industrial, technical, health occupations, cooperative occupational and distributive education in lieu of three units each in vocational agriculture and industrial arts.

---

[1] Handbook for Classification . . . ., 1980.

Finally, in its section clarifying some of the legislative requirements, the Missouri DESE Handbook for Classification . . . states:

> "The program shall consist of at least one unit of credit in each of the areas of communication skills, mathematics, science, social studies, fine arts, practical arts and physical education and shall satisfy specific legal requirements. The student shall complete at least one unit of credit in each of the seven areas during grades nine and above. A pupil who has completed the equivalent of 1 unit in practical arts in the 7th and/or 8th grade of a departmentalized junior high school may be excused from meeting the high school graduation requirement in this area." (p. 41)

3. Evaluating Student Performance

ITE instructors are routinely expected to assess and document student progress towards their (and the program's) competency goals. Clearly student evaluation is an integral part of teaching and with the implementation of instructional management systems it becomes even more important. Instructors should be careful not to allow themselves to consider evaluation as an intrusion, as something that takes away from instruction/learning time. Indeed, when properly handled, student evaluation will maximize the effectiveness of their instruction.

To implement a systematic and effective evaluation scheme instructors should note that:

- Basically evaluation is the part of teaching that assesses each student's progress towards documented course and individual goals and objectives (such as the mastery of certain competencies).
- Feedback should be provided in a constructive manner so as to encourage desired action.
- Self-evaluation by the student is an essential part of the overall evaluation process.
- Each domain of behavior should be assessed by the evaluation system. Avoid one-dimensional evaluation (e.g.: only knowledge or only psychomotor skills).
- There is a difference between evaluation and grading. The former ascertains the student's level of performance -- the latter applies judgments to these assessments and links them to the system's grading scale.
- In the junior high levels, considering the developmental stage of the students, those who make an effort but fall short should not be failed merely because a lack of knowledge, skills, or attitude. At the same time, students should receive average or above average grades only for documented accomplishment.

Purposes for Student Evaluation

Two major purposes guide teacher evaluation of student performance. They are typically called formative and summative evaluation

Formative evaluation is intended to have a shaping, guiding or other similar influence on students. It is administered before and/or during the learning process and as such it serves to give students feedback as to how they are doing. Because of this it is usually considered to be less threatening than other forms of evaluation. Often it is self-administered by the student and may not even need to be revealed to the instructor -- depending on the maturity level of the student.

Summative evaluation occurs at the end of some learning episode. This could be after a lesson, a major unit, a semester or a course. The purpose of this type of evaluation is to document how much and/or how well a student has mastered the target competencies at that given point in time.

Typically summative tests are administered at the end of each major unit of instruction and at the end of each course. Such tests must systematically sample the target objectives/competencies that were taught in that unit or course. This would best be accomplished by developing a table of specifications that matrixes objectives to test questions and levels of behavior. The results of such tests would then be recorded on progress charts, in grade books and/or in an instructional management system. This then yields a competency profile valid up to the date of testing.

Pretesting

Often instructors will wish to pretest their students prior to the beginning of a course or major unit. This is a highly recommended practice because it can tell them whether students:

- Have the prerequisite competencies necessary for success in the unit or course that is about to begin.
- Have mastered some or all of the competencies the unit or course is designed to develop.

The first readout can help the instructor identify and secure remedial help for deficient students. This can be used to bring weak students up to speed rather than slowing the entire class to accommodate their weakest member. The second readout would alert the instructor to allow advanced students to move at their own pace and reduce their likelihood of getting bored, disillusioned and/or disruptive.

Evaluation Techniques

Just as in teaching, the richer the variety of methods used for evaluation, the richer the learning experience will be for the students. Effective ITE instructors will employ a wide range of such techniques in addition to the standard observation, oral questioning and informal evaluation. Some of the more formal approaches includes:

Progress Charts. These serve as a visible reminder to all students of their progress. If posted openly, it also shows how they compare to their classmates -- a situation that has to be carefully monitored because of privacy issues. Progress charts can easily be used to track mastery of competencies in each domain although they tend to be used more frequently with skill or job accomplishment.

Self- or Progress Checks. Especially when assigning more complicated and lengthy activities, it is desirable to encourage students to assess their own progress along the way. This is a lot better than having students find themselves short of the goal at the end of a long work period. Typically such progress checks are checklists of critical events or applicable criteria stated with enough detail and clarity that the student can assess his/her accomplishment of each step.

Rating Scales. Most often used to evaluate a finished project, activity or attitude, these scales can be completed by either the student, his/her peers or by the instructor. Typically such a scale evaluates the work, according to established standards on a scale of 1 - 5. A sample is shown in Figure VI-7. Because of the standardizing effect such scales have, they help increase the instructor's objectivity across pupils and students. Additionally, if given to students in advance as is suggested, such scales help them learn and clarify what is expected of them. This is particularly important for affective performance measures. Figure VI-8, an example from Missouri's Introduction to Vocational Education Instructional Management manual, provides an excellent format for documenting attitude measures. Such scales can also identify the weight placed on such criteria as:

- Accuracy and precision
- Finish
- Craftsmanship
- General design
- Degree of complexity/difficulty
- Time used
- Work habits
- Originality
- And many others.

Achievement Tests. Sometimes these are considered appropriate only for the cognitive domain (i.e., what students know) but this is a mistake. Properly constructed performance tests are also excellent for validating mastery of sensori-motor competencies.

Instructors should be careful to evaluate only against the clearly stated goals/objectives of a course, major unit or lesson. Such tests need to be developed to measure the appropriate level of performance in each domain. The most systematic manner to insure this is to use a table of specifications that indicates how many questions, and which levels, will be used to assess each objective.

Good tests must be valid and reliable. Validity is simply that a test measures what it is supposed to measure and not something else. Reliability is the characteristic that insures the results are the same each time people with the same capability are evaluated. Also, good tests must necessarily discriminate between students who have mastered the desired competencies and those who have not. Effective tests are moderately difficult, they are systematically representative of the objectives and content, they are clearly objective in their assessment and they are reasonable in terms of their length (time).

Instructors are advised to keep an ongoing bank of test questions and that each question be coded to an objective and to where the answer may be found, e.g., textbook page. Another desirable practice is to submit major unit and course tests to an item analysis program. This gives the instructor an excellent insight into the quality of his/her test and thereby encourages refinement for the next time. With the increasing number of test-scoring machines in the schools, such programs are more easily available.

Oral Test/Questioning. Typically this kind of evaluation is one of the mainstays of ITE. It works well to check on reading and other homework assignments and as a preliminary review for major written tests. To increase objectivity and systematic coverage, it is recommended that instructors develop the questions and an answer key in advance of the administration of an oral test. Similarly a form for recording responses helps utilization of the oral questionings results.

Figure VI-7

Sample Rating Scale

Course: ______________________________ Date: __________

Lesson # ________ Title: ______________________________

Student:______________________________________

Performance Rating

TASK Poor 1 2 3 4 5 Excellent

1. Clean copper soldering iron tip with file ___:___:___:___:___
2. Plug from soldering iron ___:___:___:___:___
3. . . . . ___:___:___:___:___
4. . . . . ___:___:___:___:___
5. . . . . ___:___:___:___:___
6. . . . . ___:___:___:___:___
7. . . . . ___:___:___:___:___
8. . . . . ___:___:___:___:___
9. . . . . ___:___:___:___:___
10. . . . . ___:___:___:___:___
11. . . . . ___:___:___:___:___
12. Solder connections (proper amounts of heat and solder) ___:___:___:___:___

Total: ______

Figure VI-8

Affective Performance Objective Format[1]

Given ____

____

(Specify setting where performance is to be demonstrated and any other conditions that may exist.)

The ______________________ student will:
(Specify program)

____
(Write in the affective performance expected)

____

This attitude (affective performance) will be judged "satisfactory" if the following criteria (indicators) are observed/measured by the evaluator:

The Student

Does	Doesn't
1. ______________	1. ______________
2. ______________	2. ______________
3. ______________	3. ______________
4. ______________	4. ______________
5. ______________	5. ______________
6. ______________	6. ______________
7. ______________	7. ______________
8. ______________	8. ______________

---

[1] Introduction to Vocational Instructional Management Systems.

Improving Written Tests

Written tests can take many forms: true/false, multiple choice, matching, short answer and essay are among the most frequently used. The Texas Industrial Technology Curriculum Guide (p. 278-9) provides the following suggestions to improve the quality of evaluation:

"Written tests should contain a sufficiently large number of the significant items selected from the content included in the course. They should include a variety of types of items each phrased in suitable vocabulary with an appropriate range of difficulty. Tests should be attractive and easy to read. Drawings and sketches may be used effectively in test items and they may help to make the test interesting to the student. Test directions should be brief, but definite. . . .

Items used on written tests generally fall into three categories: essay, recall and recognition. Multiple choice, true-false and matching items are of the recognition type while listing and completion items are of the recall type.

- The essay type of item requires that a student understand the subject matter thoroughly and express this knowledge in written form. When essay items are used, care should be taken that the topic is of major importance to the course. Since a considerable amount of time is required to write an essay answer, this type of examination usually involves a limited sampling of the total area of instruction. Subjective judgment is required in the scoring of essay type answers. However, a careful analysis of the material encompassed in the item and the preparation of a rating scale may help to make scoring of these items more objective. The instructor should be alert to the writing ability of the student when he/she uses essay tests.

- Recall items require the student to complete a statement, supply an answer to a question, or list certain items. The answer may involve simple facts or concepts that are of importance to the work, or may require the solution of a problem which applies these concepts. Scoring of items of this type requires reading the answers and applying judgment in cases where several different words could supply the same meaning. This task is easier if spaces for the answers are placed at the left of the page rather than in the text of the items. If separate answer sheets are used, they should be ruled or printed to provide uniform spacing for the answers.

- Recognition type test items require that the student select a response from a number of given possibilities. Properly constructed recognition type items provide a desirable means of objective testing, since the respondent must choose one correct or best answer. Recognition type items lend themselves well to the use of printed answer sheets, perforated scoring masks and computer scoring (added).

Students may guess right answers for recognition items; however, the effects of guessing are decreased as the number of items in a given test is increased. A true or false test should contain at least fifty items to reduce the effects of guessing. The guessing factor in multiple choice or matching items is less important if four or five plausible choices are provided."

Grading

After evaluation mechanisms are employed, ITE instructors face the challenge of converting these results into a grade. This is typically a difficult task because it involves a considerable amount of professional judgment. Here the instructor must be careful to be:

- Fair to students regardless of their personal feelings.
- Consistent from class to class.
- Systematic in assessing all desired dimensions of performance.
- Accurate to avoid mistakes.
- Free from bias of any kind.

One of the best ways to meet such high criteria is to carefully document the evaluation criteria and grading system. When looking at a system on paper, the errors and weak assumptions just seem to "jump out" at you. A sample of a systematic procedure is provided in Figure VI-9 An instructor would use this by:

1. Listing columns, across the top of the table, that identify each of the major evaluative criteria. In this example, columns 2, 3 and 4 show us that written tests, performance tests and behavior traits are being judged.
2. Listing columns, across the top and after the performance dimensions, that reflect the weight placed on each dimension. In this example columns 5, 6 and 7 respectively show weights of 30%, 50% and 20%.
3. Providing columns (#'s 8 and 9) for total points earned and the corresponding letter grade.
4. Students' names are listed downwards in column 1.
5. Across the bottom row indicate the maximum number of possible points that a student can earn in each performance domain. In this example note that students can earn a maximum of 150 points as the sum of all written test scores, a maximum of 150 points as the sum of all performance test rating scales and a maximum of 50 points on the behavior traits (attitude and behavior) ratings.
6. Then enter each student's total points in each performance domain column (#'s 2, 3 and 4).
7. Next, work out the weighted points earned for each performance domain by using the formula as shown. Record the result in the appropriate WPE column (e.g. 5, 6 or 7).
8. Add points in columns 5 + 6 + 7 and record the sum in column 8.
9. List scores in order from high to low in the distribution column. Use your judgment to draw the breaks/division lines that separate A from B from C, D and F performance. In the example shown, the instructor had very high standards. If the material was well covered, remediation and sufficient time provided such standards may be appropriate. Enter the letter grades in column 10.

Figure VI-9

Simulated Record of Scores and Grading System

Grading Period ______________ Instructor ________________ Course ________________

	Sum of Points Earned			Weighted Points Earned			Total Points Earned	Distribution column-List scores in order from High to Low	
Row/Column Student	Written Eval 2 ΣWr	Perf. Eval 3 ΣPe	Behavioral Eval 4 ΣTr	Written 5 30%Wr	Perf. 6 50%Pe	Behavioral 7 20%Tr	8 of 100%	9 ΣPoints	10 Grade
1	139	144	39	28	48	16	92	92	A
2	123	135	45	25	45	18	88	92	A
3	126	130	40	25	44	16	85	91	A
4	121	123	39	24	41	16	81	88	B
5	142	131	47	29	44	19	92	87	B
6	119	119	35	24	40	14	78	85	C
7	119	119	38	24	40	15	79	85	C
8	92	95	32	18	32	13	63	81	C
9	119	108	35	24	36	14	74	79	C
10	116	109	37	23	37	15	75	78	D
11	106	104	36	21	35	14	70	75	D
12	126	135	43	25	45	17	87	74	D
13	132	141	45	26	47	18	91	71	D
14	123	130	40	25	44	16	85	70	D
15	110	104	34	22	35	17	71	63	F
16	97	92	30	20	31	12	63	63	F
Maximum Possible (T)	150	150	50	30	50	20	100		

Formula for columns 5, 6 & 7:

e.g., for student 1, the WPE for written performance (column 5) is:

Weighted Points Earned = (ΣWr or ΣPe or ΣTr/T) (100) x (p) = WPE = (139/150) x (100) x (30%)
= 93 x (100) x (30%)
= (93) x (.30)
= 28 (Rounded)

Legend

T = Total points possible for the given performance domain
p = Weight given to the designated performance domain
ΣWr = Total points earned by student in written performance domain (column 2)
ΣPe = Total points earned by student in skill performance domain (column 3)
ΣTr = Total points earned by student in behavior performance domain (column 4)

4. Evaluating ITE Teacher Effectiveness

Invariably ITE instructors will find their own performance being evaluated -- both formally and informally. It will be important to insure that the formal process documents the quality of their performance in such a manner that ad hoc and/or ill-informed informal judgements do not jeopardize one's chances for tenure and/or merit raises.

ITE instructors will typically find themselves evaluated on a wide range of criteria. Usually they include:

- Instructional effectiveness
- Motivational ability
- Facility management
- The extent to which one contributes to the school
- Overall program quality

It is recommended that ITE instructors deliberately seek formal supervisor and administrator evaluations each year. It is important that such evaluations are carefully done, that they represent an effort commensurate with the importance of instructor evaluation and that they highlight the instructor's strengths and weaknesses. Then, it is vital that all identified weaknesses also are accompanied by a list of recommended actions that could eliminate the weaknesses. As Missouri moves towards more accountability it will be important to keep careful records of such evaluations and to systematically document all progress towards improvement.

As with program evaluation, it is thought that the most effective (in terms of promoting improvement) form of evaluation is self-evaluation. Individual ITE instructors might well wish to consider how well their teaching meets the criteria set out in the Texas Industrial Technology Curriculum Guide (p. 279, 280):

1. "There is a definitive statement of goals to be achieved.

2. The instructional program developed out of a direct concern for the most appropriate methodology to accomplish a given goal.

3. The methodology takes into account the learning and performance needs of the learner with respect to the goal(s) to be accomplished.

4. The goals of the experience are understood by the student and the teacher.

5. The goals are realistic in terms of the student's capabilities, program time limitations, physical facilities, teacher competencies and methodological considerations.

6. More important goals should receive greater consideration in weight in evaluation than less important goal.

7. The instructional procedures are selected to provide for the greatest degree of student involvement with the subject matter."

Perhaps one of the more effective ways to evaluate one's teaching performance is to have a respected colleague sit in during several of your classes. Thereafter, ask him/her to critique what they observed. It is often useful to have this done by both other ITE instructors and also by non-ITE teachers. Both can yield unique and valuable perspectives. Instructors may also find it useful to videotape their lesson and then analyze what they see themselves. Figure VI-10 presents an analysis and rating sheet useful to external evaluation as well as for self-evaluation.

Figure VI-10

Lesson Presentation Evaluation Sheet

Teacher ______________________ Date ______________

Subject Area ______________________ Grade ________ Visit No. ________

Title of lesson ____________________________________

Lesson Type: Lecture_____ Demonstration_____ Video-tape Number_____ Counter_____ -_____

Rating scale:

E = Excellent = 3 A = Average = 2
W = Weak = 1 U = Unsatisfactory = 0

1.	Lesson objective(s) was made known to the student	0	1	2	3
2.	Lesson introduction established a feeling of need and created interest.	0	1	2	3
3.	All needed supplementary teaching/learning items were ready.	0	1	2	3
4.	Appropriate information assignments (text, reference books, information sheets, etc.) were given.	0	1	2	3
5.	Instructor maintained proper position for all students to see and hear.	0	1	2	3
6.	Instructor talked to the class, not to the tools or materials.	0	1	2	3
7.	Sufficient use was made of supplementary teaching items.	0	1	2	3
8.	Vocabulary was appropriate.	0	1	2	3
9.	Interaction items were asked at proper checking points.	0	1	2	3
10.	A. Lesson followed topical outlines.	0	1	2	3
	B. Demonstration - one idea was presented at a time and tied to the next.	0	1	2	3
11.	Appropriate teaching method(s) selected to accomplish objectives.	0	1	2	3
12.	Instructor displayed a high degree of skill.	0	1	2	3
13.	Instructor maintained poise throughout.	0	1	2	3
14.	Instructor stayed on the subject.	0	1	2	3
15.	Safety precautions were stressed.	0	1	2	3
16.	Lesson length fits content.	0	1	2	3
17.	Summation and closure were established.	0	1	2	3
18.	Follow-up activities designed for immediate applications were provided for.	0	1	2	3
19.	Unit test items were prepared.	0	1	2	3
20.	Instructor followed written lesson plan.	0	1	2	3

Assessment Scale: Excellent = 54-60, Average = 48-53, Weak = 40-47, Unsatisfactory < = 40 Total = __________

Performance Based Evaluation

Missouri's legislature in 1983 created a law (section 168.128) which details the requirements for teacher evaluation. A copy of the relevant section is provided in Guidelines for Performance Based Teacher Evaluation in Missouri, a publication available from the Missouri DESE. This document also highlights the background, philosophy and procedures of the recommended teacher evaluation process. Essentially it sets out that:

- The principal is responsible for the performance based teacher evaluation system.
- Performance based teacher evaluation systems "should include a **formative** evaluation phase. The formative phase should include both scheduled and unscheduled classroom observations. A pre-observation conference should occur prior to scheduled observations. Formative evaluation includes the classroom observations designed to help teachers improve their performance by providing feedback and suggestions regarding their teaching skills.
- The summative phase of the evaluation process is a composite of information obtained through the formative observations and may serve as the basis for administrative decision making. A summative evaluation should be completed for a probationary teacher each year. For tenured teachers, a summative evaluation should be completed at least once every three years or as necessary to best serve the instructional process.
- A post-observation conference should be conducted within a reasonable period of time following each classroom observation. This conference should include a discussion of identified strengths and weaknesses. Job targets for maintaining and improving teacher performance should be completed for a probationary teacher each year.
- The evaluation system should include an appeal process defined within local school district policy."

Figure VI-11 presents 19 criteria suggested for performance based teacher evaluation systems. The original document then provides useful descriptions for each of these criteria. Figures VI-12 and VI-13 present Missouri's recommended worksheets useful for the formative and summative parts of the process.

It is important for the ITE instructor to point out to his/her administrator the differences in operating a laboratory-based program from one that is conducted in a typical "normal" classroom. Perhaps the best way to address these differences is to weight the performance criteria used for ITE instructors differently than those used for "classroom" teachers. It would seem, for example, that since the Classroom Management criteria shown in Figure VI-11 are particularly more significant to the success of ITE it would be appropriate to weight them more heavily.

Figure VI-14 then presents the results in terms of a job target sheet. This is intended to clarify improvements that would enhance the teacher's effectiveness, the procedures to achieve the improvement, the approval methods to be used to measure achievement and the timelines for accomplishment of the goals.

Figure VI-15 is the recommended summative evaluation form that assesses teacher performance against the criteria in terms of performance levels. Furthermore it highlights what is considered desirable (performance expectations) and it identifies how one might exceed these expectations.

Figure VI-11

19 Suggested Criteria for Performance-Based Teacher Evaluation[1]

I. Instructional Process

The Teacher:

- A. Demonstrates appropriate preparation for classroom instruction.
- B. Implements a variety of effective teaching techniques.
- C. Provides opportunities for individual differences.
- D. Implements instructional objectives effectively.
- E. Demonstrates a knowledge of subject matters.
- F. Uses a variety of teaching materials effectively.
- G. Uses instructional time effectively.
- H. Demonstrates ability to motivate students.
- I. Demonstrates ability to communicate effectively with students.
- J. Provides students with specific evaluative feedback.

II. Classroom Management

The Teacher:

- A. Organizes classroom environment to promote learning
- B. Manages student behavior in a constructive manner.

III. Interpersonal Relationships

The Teacher:

- A. Demonstrates positive interpersonal relations with students.
- B. Demonstrates positive interpersonal relations with parents/patrons.
- C. Demonstrates positive interpersonal relations with education staff.

IV. Professional Responsibilities

The Teacher:

- A. Participates in professional growth activities.
- B. Follows the policies and procedures of the school district.
- C. Assumes responsibilities outside of the classroom as they relate to the school.
- D. Demonstrates a sense of professional responsibility.

---

[1] Guidelines for Performance Based Teacher Evaluation in Missouri, 1984.

Figure VI-12

Pre-Observation Worksheet[1]

Teacher ______ Date ______ School ______

Subject ______ Grade ______ Period/Time ______

Teacher completes this form and discusses content with administrator prior to scheduled observation.

1. What are the lesson objectives?	2. Which of the steps of the teaching act will take place? ______ Develop anticipatory set ______ State objectives, why they are needed ______ Provide input ______ Model ideal behavior ______ Check for comprehension ______ Provide guided practice ______ Provide independent practice ______ Achieve closure
3. What teaching/learning activities will take place?	4. How are you going to check student understanding and mastery of the lesson objectives?
5. What particular teaching behaviors do you especially want monitored?	6. Are there any special circumstances of which the evaluator should be aware?
NOTES:	NOTES:

Teacher/s Signature/Date ______ Evaluator's Signature/Date ______

(Signatures simply imply that information has been discussed)

---

[1] Guidelines for Performance Based Teacher Evaluation in Missouri, 1984.

Figure VI-13

Formative Observation Form[1]

Teacher　　Date　　School

Subject　　Grade　　Period/Time

1. Instructional Process Characteristics

- a. Establishes set
- b. States objectives
- c. Provides input
- d. Models ideal behavior
- e. Checks for comprehension
- f. Provides guided practice
- g. Provides independent practice
- h. Achieves closure

2. Performance Criteria

- a. Demonstrates appropriate preparation for classroom instruction.
- b. Implements a variety of effective teaching techniques.
- c. Provides opportunities for individual differences.
- d. Implements instructional objectives effectively.
- e. Demonstrates a knowledge of subject matter.
- f. Uses a variety of teaching materials effectively.
- g. Uses instructional time effectively.
- h. Demonstrates ability to motivate students.
- i. Demonstrates ability to communicate effectively with students.
- j. Provides students with specific evaluative feedback.
- k. Organizes classroom environment to promote learning.
- l. Manages student behavior in a constructive manner.
- m. Demonstrates positive interpersonal relationships with students.

COMMENTS:　　**COMMENTS:**

Teacher's Signature　　Evaluator's Signature

(Signatures simply imply that information has been discussed.)

---

[1] Guidelines for Performance Based Teacher Evaluation in Missouri, 1984.

Figure VI-14

Job Target Sheet[1]

Teacher	Date	School

1. Performance Area:

2. Criterion*:

3. Improvement Objective(s): (Applicable descriptors and/or definable deficiencies)

4. Procedures for Achieving Objective(s): (Explanation of teacher & administrator responsibilities)

5. Appraisal Method and Target Dates:

6. Teacher's Comments:

7. Evaluator Comments:

Teacher's Signature	Evaluator's Signature/Date

Date Objective Achieved: ____________

Evaluator's Signature

Evaluator's Signature

(Signatures simply imply that information has been discussed)
*One Job Target Sheet should be used for each criterion

---

[1] Guidelines for Performance Based Teacher Evaluation in Missouri, 1984.

Figure VI-15

Summative Evaluation Report[1]

Summative Evaluation Report

Teacher ____________ Date ________

Performance Area I: **The Instructional Process**

CRITERIA* The Teacher...		**Performance Levels**		**PERFORMANCE EXPECTATION**	**In Addition to Performance Expectation**
A. Demonstrates appropriate preparation for classroom instruction	**Not observed A I	Does not prepare for classroom instruction	Sometimes prepares for classroom instruction	Consistently prepares for classroom instruction	Displays evidence of superior preparation for classroom instruction
B. Implements a variety of effective teaching techniques	Not observed A I	Shows little or no evidence of variety in teaching strategies	Intermittently uses variety in teaching strategies which are effective	Uses a vareity of teaching strategies which are effective in achieving lesson objectives	Develops exceptional teaching strategies to meet individual needs
C. Provides opportunities for individual differences	Not observed A I	Does not provide for individual rates of learning and capabilities	Intermittently provides for individual rates of learning and capabilities	Provides for individual rates of learning and student capabilities	Provides maximum instructional opportunities for individual learning styles
D. Implements instructional objectives effectively	Not observed A I	Shows little or no evidence of implementing instructional objectives	Intermittently implements instructional objectives	Implements instructional objectives	Goes beyond the requirement of instructional objective
E. Demonstrates a knowledge of subject matter	Not observed A I	Demonstrates an insufficient knowledge of subject matter	Demonstrates limited knowledge of subject matter	Demonstrates adequate knowledge of subject matter	Demonstrates superior knowledge of subject matter
F. Uses a variety of teaching materials	Not observed A I	Uses materials which are irrelevant to the instructional objectives	Intermittently uses materials which are relevant to the instructional objectives	Uses materials which are relevant and appropriate to the instructional objectives	Seeks out and/or develops a variety of creative materials appropriate to the instructional objectives
G. Uses instructional time effectively	Not observed A I	Shows little or no evidence of maintaining students on the learning task	Sometimes maintains students on the learning task	Maintains students on the learning task	Is extremely skillful in maintaining students on the learning task
H. Demonstrates ability to motivate students	**Not observed A I	Shows little or no evidence of motivating students to perform to their abilities	Occasionally motivates students to perform assigned tasks, but inconsistently requires students to perform according to their abilities	Clearly expects and motivates students to perform assigned tasks to their abilities	Motivates students to achieve beyond previous performance levels
I. Demonstrates ability to communicate effectively with students	Not observed A I	Does not communicate clearly; students often appear confused	Sometimes communicates clearly, but does not encourage student input	Communicates clearly and encourages relevant dialogue	Is extremely skillful in using a variety of verbal and non-verbal communications
J. Provides students with specific evaluative feedback	Not observed A I	Gives no evaluative feedback	Is inconsistent in giving evaluative feedback	Gives specific evaluative feedback	Gives feedback with reinforcement and encouragement

Performance Area II: **Classroom Management**

A. Organizes classroom environment to promote learning	**Not observed A I	Displays little or no skill in organizing the classroom learning environment	Ineffectively manages the classroom learning environment	Maintains a functional classroom learning environment; selects appropriate activities	Assesses and adjusts the setting to provide for a variety of learning styles
B. Manages student behavior in a constructive manner	Not observed A I	Shows little or no classroom control	Is inconsistent in controlling pupil behavior	Establishes and maintains effective discipline	Plans and implements strategies for pupil self-discipline

---

[1] Guidelines for Performance Based Teacher Evaluation in Missouri, 1984.

Figure VI-15

Summative Evaluation Report[1]

CRITERIA* The Teacher. . .		**Performance Levels**		**PERFORMANCE EXPECTATION**	**In Addition to Performance Expectation**
Performance Area III: **Interpersonal Relationships**					
A. Demonstrates positive interpersonal relationships with students	**Not observed A I	Is unresponsive to the needs of students	Intermittently shows sensitivity to the needs of students	Demonstrates sensitivity to all students	Willingly provides extra efforts to meet the needs of students
B. Demonstrates positive interpersonal relations with educational staff	Not observed A I	Shows little or no interest in interacting with educational staff	Intermittently shows interest in activities of educational staff	Works well with members of educational staff	Provides leadership to promote a good working relationship with educational staff
C Demonstrates positive interpersonal relationships with the parents/patrons	Not observed A I	Shows little or no interest in interacting with parents/patrons	Intermittently shows interest in the activities and needs of the parents/patrons	Works well with parents/patrons	Provides active leadership to promote a good working relationship with parents/patrons
Performance Area IV: **Professional Responsibilities**					
A Participates in professional growth activities	**Not observed A I	Shows no interest in professional growth activities	Occasionally participates in professional growth activities	Seeks out and voluntarily participates in relevant professional growth activities	Initiates professional growth activities encourages other staff to participate in professional growth activities
B Follows the policies and procedures of the school district	Not observed A I	Does not comply with school and district regulations and policies	Intermittently complies with school and district regulations and policies	Fully complies with school and district regulations and policies	Provides leadership in the development/improvement of school and district regulations and policies
C Assumes responsibilities outside of the classroom as they relate to school	Not observed A I	Does not assume out-of-class responsibilities	Intermittently assumes out-of-class responsibilities	Performs out-of-class responsibilities for smooth operation of the school	Is self-motivated, assumes extra responsibilities willingly
D Demonstrates a sense of professional responsibility	Not observed A I	Does not fulfill directed school responsibilities	Needs to be reminded to meet directed school school responsibilities	Fulfills directed school responsibilities	Is self-motivated, assumes extra responsibilities willingly

COMMENTS:

COMMENTS:

Teacher's Signature/Date

Evaluator's Signature/Date

(Signatures simply imply that information has been discussed)

---

[1] Guidelines for Performance Based Teacher Evaluation in Missouri, 1984.

Notes:

5. Resources

________. 1986-1988 Missouri State Plan for Vocational Education. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, Division of Career and Adult Education, 1985.

________. Educational Goals for the State of Missouri. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, n.d.

________. Evaluative Criteria. Technology Education. (Industrial Arts Education) Section. Falls Church, VA: National Study of School Evaluation, sixth edition, 1987.

________. Guidelines for Performance Based Teacher Evaluation in Missouri. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, June 1984.

________. Handbook for Classification & Accreditation of Public School Districts in Missouri. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, 1980.

________. Handbook for Industrial Arts Education. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, 1977, [IA-2-1].

________. Handbook for Vocational Education. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, Division of Career and Adult Education, 1981.

________. Introduction to Vocational Education Instructional Management. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, May 1984.

________. Standards and Evaluation Criteria for Industrial Arts Programs (Public and Private, 7-12). Jefferson City, MO: Missouri Department of Elementary and Secondary Education, 1978.

Barnes, James L. Systems of Technology: Organization and Management of Instruction Handbook. Austin, TX: University of Texas-Austin, Center for Occupational Curriculum Development, 1984.

Dugger, Jr. William et al. Standards for Technology Education Programs. Standards for Technology Education Project. Virginia Polytechnic Institute and State University. South Holland, IL: Goodheart-Wilcox, 1985.

Elias John E. & Dyrenfurth, Michael J. Administrator's Handbook. Vocational Program Evaluation Project. Columbia, MO: Department of Practical Arts and Vocational-Technical Education, University of Missouri-Columbia, 1980.

Mayfield, W.A. & Payne, Jim. Curriculum Guide for Industrial Technology. Austin, TX: Texas Industrial Arts Association, n.d.

Miller, Patrick W. & Erickson, Harley E. Teacher-Written Student Tests: A Guide for Planning, Creating, Administering and Assessing. Washington, DC: National Education Association, 1985.

Pautler, Albert J., Jr. Evaluation Hints for Vocational Teachers. Chicago, IL: American Technical Society, 1977.

Walencik, Vincent, J. User's Manual: Standards for Industrial Arts in New Jersey. Upper Montclair, NJ: Montclair State College, 1986.

Notes:

Chapter VII

Meeting Professional Responsibilities

1. Introduction

Be a professional. Industrial Technology Educators are professionals. There must be no doubt in the public's mind, and in the perception of our colleagues in education, that we industrial technology educators are members of the profession and that we belong!

This necessitates that we think and carry ourselves as professionals. To help us do this, this chapter highlights key responsibilities we must accept. Additionally the profession's ethical standards are presented as are the relevant points of pre- and in-service education. Finally, the chapter concludes with some suggestions for increasing our involvement with the larger profession -- in our region, state and nation.

Notes:

2. Addressing Professional Responsibilities

Responsibilities

Industrial Technology Educators (teachers and supervisors) have many overlapping areas of responsibility. The primary responsibilities are to serve youth, to be effective and to participate in the profession. Within these three primary charges lies the core of the teacher's responsibility and profession. Specifically, ITE instructors are expected to:

- Manage the ITE facility
- Prepare budgets and assist in the purchasing process
- Familiarize themselves with the characteristics of their students
- Concern themselves with student value systems
- Move students along at a pace commensurate with their talent
- Develop and/or select appropriate instructional materials
- Evaluate the ITE program's effectiveness
- Control disbursement of consumable supplies
- Maintain appropriate discipline
- Provide a safe facility and instruct to insure safe operation within it
- Develop courses of study
- Assess and further the efficiency and effectiveness of their instruction
- Establish and secure approval for ITE policies
- Impart knowledge, attitudes and skills consistent with the acknowledged goals of ITE
- Supervise student laboratory activities
- Attend to the demands of individual differences and special needs
- Systematically assess, record and communicate student progress
- Keep current in their technological field
- Reward performance and motivate students towards it
- Follow school policy

The literature is full of such long lists of duties that detail each of the major responsibilities. More important than memorizing these lists is that industrial technology educators internalize them. In other words, that they become an integral part of one's being. Some representative behaviors that would exemplify such internalization include:

- Annually participating in MITEA and MVA state conferences.
- Attending ITEA and/or AVA national conferences at least periodically (every 2-5 years)
- Actively looking for, and participating in, in-service opportunities each year.
- Evaluating one's performance systematically and on an ongoing basis.
- Developing and implementing personal and local ITE program improvement plans.
- Sponsoring student organizations such as AIASA.
- Effective management of the ITE facility, equipment and supplies.
- Systematic documentation of the ITE curriculum.
- Maintaining a high degree of accuracy in grading and performance records.
- Emphasizing safety throughout the ITE program.

- Attending to public relations for the ITE program and school.
- Developing a long-range budget.
- Participating in extra-curricular activities.
- Using individualized instruction as appropriate.
- Maintaining effective discipline.
- Helping other teachers and participants in school and program activities.

But teachers are not alone in having responsibility pertaining to the education of youth. Increasingly education is being considered a partnership of parents, the community and schools. To this end the national PTA has adopted a position of importance. Shown in Figure VII-1, this states:

Figure VII-1

Individual and Organizational Rights and Responsibilities in the Education of Children[1]

The National PTA believes that the primary responsibility for the education of children lies with the family. Parental involvement begins before the child's birth and should continue until the child reaches adulthood. That involvement takes many forms, including the parent's shared responsibility in decisions about the child's education, as well as the parent's participation in organizations that reflect the community's collective aspirations for the education of all children.

A Parent's Responsibilities

The parent, as a role model and initial teacher, has a responsibility to:

- safeguard and nurture the physical, mental, social and spiritual education of the child;
- instill respect for self, for others and for learning;
- provide opportunities for interaction with other children and adults;
- lay the foundation for responsible citizenship;
- provide a home environment that encourages and sets an example for the child's commitment to learning;
- know, help and interact with the child's teachers and administrators;
- participate in the selection of responsible school board members.

A Parent's Rights

A parent has a right to have:

- clear, correct and complete information about the school and his/her individual child's progress;
- confidentiality of information about his/her individual child;
- clear understanding of the processes to gain access to the appropriate school officials, to participate in decisions that are made, and to appeal matters pertaining to his/her individual child

Parents and other adults function outside the sphere of their own family by joining with interested parents and others to affect the education of all children.

Organizational Responsibilities

The membership of the PTA has a responsibility to:

- protect access to a quality education for all children;
- seek information on policies, curriculum and laws that affect children;
- share accurate information with its membership and the school community;
- know, help and interact with teachers and administrators;
- be willing to accept responsibilities for the vitality of the PTA to assure an active PTA;
- work within the PTA and the school in a constructive manner with respect for democratic procedures and a tolerance for a diversity of opinions;
- work in partnership with school professionals to determine appropriate levels of program and services;
- participate in decisions affecting policies, rules and regulations

---

[1] Position adopted by National PTA Board of Directors, June, 1986

Figure VII-1, Continued

Individual and Organizational Rights and Responsibilities in the Education of Children

Organizational Rights

A PTA has the right to:

- function as an independent, non-partisan child advocacy group;
- seek enactment of policies and practices which protect children and youth;
- participate, within school board policy, in the setting of the school goals and assist in the review of teaching materials;
- participate in decisions affecting policies, rules and regulations;
- meet with appropriate school officials to discuss matters of mutual concern affecting all children

The National PTA supports the concept of public schools because PTA believes they provide a common experience to ensure a democratic society. Within the rights and responsibilities of individual parents and organizations, the National PTA believes options and alternatives within the public schools should ensure that:

- the community sustain a viable public school system;
- parents have the opportunity for involvement in their children's schools;
- appropriate transportation be provided for students to ensure equity;
- specialized schools provide for a fair selection process;
- standards governing school curricula, personnel and student performance provide access to equal opportunities for students;
- adequate and objective information be available to parents so that they can make informed decisions.

Ethics

Generally each profession has a code of ethics that governs behavior and teaching is not different. These codes help new teachers learn what is expected of them. They allow identification of inappropriate behavior and they help communicate the profession's ideals to the public. The NEA has developed and maintained such a code for years. The code is both simple and powerful at the same time. It is presented in Figure VII-2.

Closer to home, the MSTA also developed a professional code of ethics. This code is shown in Figure VII-3. It is interesting to note that the NEA's code identifies many of the practices which educators should avoid while the MSTA's code speaks more positively towards the profession's ideals but with less detail.

Figure VII-2

NEA Code of Ethics of the Education Profession[1]

Preamble

The educator, believing in the worth and dignity of each human being, recognizes the supreme importance of the pursuit of truth, devotion to excellence and the nature of democratic principles. Essential to these goals is the protection of freedom to learn and to teach and the guarantee of equal educational opportunity for all. The educator accepts the responsibility to adhere to the highest ethical standards.

The educator recognizes the magnitude of the responsibility inherent in the teaching process. The desire for the respect and confidence of one's colleagues, of students, of parents and of the members of the community provides incentive to attain and maintain the highest possible degree of ethical conduct. The *Code of Ethics of the Education Profession* indicates the aspiration of all educators and provides standards by which to judge conduct.

The remedies specified by the NEA and/or its affiliates for the violations of any provision of this *Code* shall be exclusive and no such provision shall be enforceable in any form other than one specifically designated by the NEA or its affiliates.

PRINCIPLE I

Commitment to the Student

The educator strives to help each student realize his or her potential as a worthy and effective member of society. The educator therefore works to stimulate the spirit of inquiry, the acquisition of knowledge and understanding, and the thoughtful formulation of worthy goals.

In fulfillment of the obligation to the student, the educator --

1. Shall not unreasonably restrain the student from independent action in the pursuit of learning.
2. Shall not unreasonably deny the student access to varying points of view.
3. Shall not deliberately suppress or distort subject matter relevant to the student's progress.
4. Shall make reasonable effort to protect the student from conditions harmful to learning or to health and safety.
5. Shall not intentionally expose the student to embarrassment or disparagement.
6. Shall not on the basis of race, color, creed, sex, national origin, marital status, political or religious beliefs, family, social or cultural background, or sexual orientation, unfairly --
    a. Exclude any student from participation in any program.
    b. Deny benefits to any student.
    c. Grant any advantage to any student.
7. Shall not use professional relationships with students for private advantage.
8. Shall not disclose information about students obtained in the course of a professional service, unless disclosure serves a compelling professional purpose or is required by law.

---

[1] Adopted by 1975 NEA Representative Assembly, in NEA Handbook, 1986.

Figure VII-2, Continued

NEA Code of Ethics of the Education Profession

PRINCIPLE II

Commitment to the Profession

The education profession is vested by the public with a trust and responsibility requiring the highest ideals of professional service.

In the belief that the quality of the services of the education profession directly influences the nation and its citizens, the educator shall exert every effort to raise professional standards, to promote a climate that encourages the exercise of professional judgment, to achieve conditions which attract persons worthy of the trust to careers in education, and to assist in preventing the practice of the profession by unqualified persons.

In fulfillment of the obligation to the profession, the educator--

1. Shall not in an application for a professional position deliberately make a false statement or fail to disclose a material fact related to competency and qualifications.
2. Shall not misrepresent his/her professional qualifications.
3. Shall not assist any entry into the profession of a person known to be unqualified in respect to character, education, or other relevant attribute.
4. Shall not knowingly make a false statement concerning the qualifications of a candidate for a professional position.
5. Shall not assist a noneducator in the unauthorized practice of teaching.
6. Shall not disclose information about colleagues obtained in the course of professional service unless disclosure serves a compelling professional purpose or is required by law.
7. Shall not knowingly make false or malicious statements about a colleague.
8. Shall not accept any gratuity, gift or favor that might impair or appear to influence professional decisions or action.

Figure VII-3

MSTA Code of Professional Ethics

Student

- We believe our first obligation is to the students entrusted to our care.
- We believe the purpose of education is to develop each individual for his/her fullest participation in the American democratic society, to pursue truth, and to seek excellence. We will accept the responsibility of taking the initiative to eliminate all barriers that prevent full access to this unique education for all.

Profession

- We believe that academic freedom is inherent in, and essential to, the teaching profession.
- We believe that, for students to learn, teachers must be free to teach.
- We believe every educator should have a broad general education, a depth of preparation in special areas and a mastery of knowledge and skills.
- We believe an educator should be endowed with a thorough understanding of professional ethics, should possess a zeal for continuous self-improvement and should be imbued with a sense of moral and professional responsibility.

Community

- We believe that every educator has a right and a responsibility to be an informed and active citizen.
- We believe that, if the school is to relate to the students, teachers must understand the community and the home environment of all students.
- We believe free public education is an integral part of the community it serves and we shall encourage the development of educational opportunities for all.
- We believe that the continuation of our free nation and its strength and well being are dependent on free public education.

Notes:

3. Securing Preservice Preparation and Teacher Certification

As a minimum, ITE teachers need to possess a valid Baccalaureate degree from an accredited university or college. Possession of such a degree is usually the basis for which ITE certification is granted. Emergency and/or provisional and/or temporary certificates are not considered appropriate by the profession. Nor are trade & industrial or art certifications adequate to provide proper ITE instruction.

In order to be properly hired as an ITE teacher, individuals must have completed at least the minimum pre-service preparation required for state certification. In Missouri, as in most states, the certification process is actually a licensure activity. Individuals complete required courses at accredited colleges or universities in order to obtain a license to practice. A Bachelor of Science or Education degree, with specific requirements for preparation in one or more areas of industrial technology, is required in order to hold an ITE teaching position in Missouri.

The primary route to an ITE teaching position is via an industrial arts/industrial technology education or technology education degree from an accredited institution. In Missouri these institutions are the University of Missouri-Columbia and most of the regional universities and state colleges, including the School of the Ozarks. Chapter V's Table V-1 of this Guide lists the names and addresses of these schools and the appropriate departments to contact for information. A national directory of IA/ITE teacher education programs is available from the ITEA and another, the Industrial Teacher Education Directory, is available from the Council on Technology Teacher Education (c/o Dr. Ervin A. Dennis, Department of Industrial Technology, University of Northern Iowa, Cedar Falls, IA 50614; Phone 319:273-2753).

The exact course requirements for the ITE degree vary somewhat at the various institutions but they all fall within the guidelines set by the Missouri DESE and the profession. Different levels of the ITE program also require differing coursework as do differing concentrations within technology. Generally it is the case that the more areas (concentrations) and levels (K-9 or K-12) of certification an individual possesses the more opportunities they have for jobs and advancement within their current jobs. The Missouri DESE's Certification section should always be contacted directly for the most recent requirements. The current minimums established by the Missouri DESE are shown in Figure VII-4. It should be noted that these are minimums and that most teacher education programs deliberately exceed these state established minimums.

If ITE/IA certification is held in another state, the Missouri DESE should be contacted regarding reciprocity. Often at least temporary certification is qualified for. Another reason for contacting DESE is to secure the current details on Missouri Tuition Reimbursement Program. Funded by the state's concern for enhancing the quality of its education, this program reimburses teachers (pending good performance) for tuition costs of some (usually in major area certification) courses.

It is the teacher's responsibility to seek certification and re-certification when necessary. Superintendents, principals and faculty at the teacher education programs can and do assist their teachers in the process, but the responsibility ultimately rests on each individual teacher's shoulders.

Figure VII-4

Missouri Industrial Arts Teacher Certification Minimums[1]

Subjects Studied	Semester Credit Hours Required To Teach In Grades K-12	Semester Credit Hours Required To Teach In Grades K-9
Graphic Communications		
• Drafting Technology	6	3
• Graphic Arts	3	3
Energy and Power		
• Electricity/Electronics Technology	6	3
• Power Technology	3	3
Industrial Materials Processes		
• Metals Technology	6	3
• Woods Technology	6	3
• Plastics Technology	3	3
Organization and Administration of Industrial Technology Education	3	3
TOTAL	36	24

---

[1] Secondary Certification Requirements, MO DESE, Revised May 1984.

4. Using Available In-Service Education

In-service education is frequently referred to as professional development. This implies a process of keeping current within the profession. In the field of industrial technology this is a never ending process due to the nature of technology and education. Industrial technology education is therefore, a continually changing field of study which demands constant updating of our knowledge and skills.

Several types of in-service education are available: leadership development, subject matter expertise development and the pursuit of advanced degrees are but some of the more common types. All of these can be appropriate and should be considered for professional development and personal growth. Credit for these types of in-service training experiences should be approved prior to enrollment. In some districts continuing education units (CEU) are not accepted toward career ladder, certification renewal, or professional advancement.

The demand for currency within technology and one or more individual areas within it is only one of the reasons for in-service education. Another is to learn to teach more effectively. Courses offered by colleges and universities, and designed to improve teaching skills, are usually called professional education. Course work of this nature is available through the same sources as pre-service education. However, such courses are frequently made available at locations away from campus and consequently they are more convenient to attend. Increasingly Missouri's higher education institutions are offering short-term workshops for technological and professional updating. ITE instructors are encouraged to contact these institutions, and/or the state IA supervisor, for a list of what is currently offered. Typically the later also mails out a list of summer offerings each spring. Often the MITEA newsletter also carries information about in-service opportunities.

Current Missouri and district emphases on the career ladder and merit pay concepts are often coupled with school district requirements for continuing education to qualify for salary increases. In-service education seems to be an ongoing concern for all teachers because of this. Therefore, each teacher should work out a professional development plan for his/her continuing education. Preferably this should be created shortly after the teacher begins to work in the district and it should involve his/her supervisors. This plan should contain specific courses as well as a time line for their completion. If this procedure is followed, there will be fewer last minute course decisions and less "end-of-certification" cramming in order to qualify for renewal or doubt whether a course counts towards a pay raise.

Some of the best sources for technological updating are the industrial and professional associations. Groups such as the Society for Automotive Engineers, the American Welding Society and many others offer conferences and courses which disseminate a great deal of current technical information related to technology education. The Encyclopedia of Associations, often found at local public and university libraries will provide useful lists of such associations and their addresses.

Other than college/university-sponsored experiences, several additional methods exist to secure in-service training. These include industry-sponsored workshops, professional association conferences and classes, job shadowing and job switching. Information about such opportunities is usually available from Missouri's Industrial Arts Supervisor and the state's universities.

Job shadowing is a technique used to refresh old knowledge and skills, as well as to build new ones. By following a competent professional through their daily duties one can learn a lot. However, this technique is of little value if it is not conducted with thorough planning and forethought. It must not be taken lightly and must also be for an extended period of time. One afternoon of shadowing is of little use. An experience of this sort tends to be more of a show and tell situation with the industry professional acting as a tour guide, therefore it will be less educational than desired.

Job switching is an interesting concept whereby an industry professional switches jobs with a teacher for a period of time. The length of time varies depending on the industry and the professional's position. It can, however, vary from a week to a full semester. This system carries with it an opportunity to be exposed to a different view of industry but it must be carefully established to insure that proper authorization has been secured.

Notes:

5. Increasing Professional Involvement

To be professional means to be active, to participate in collegial activity, to be inquiring, to be committed. To what? To be committed to improving the practice of the profession -- as we do it ourselves and as others do it.

One of the easiest ways to increase professional involvement is to join the local, state and national professional associations. But joining is insufficient by itself. One must **participate!** Volunteer for a committee assignment, submit an article outlining an especially effective practice of yours, go to a conference . . . Frankly, the list is endless.

What type of associations are there? Several that have relevance to ITE. Their nature is different so look for a "best fit" that enables you to participate and make a contribution. The categories and some examples of such associations are:

- Trade Associations. One joins these primarily to get access to current technical information and resources pertinent to a specific aspect of industrial technology, e.g. American Metals Association, American Welding Society.
- Professional Association (in field). These associations typically all trace back to either the AVA or the ITEA. They serve to share current issues, to help member professionals, to lobby for our profession and the like. Typically they exist in local/regional, state and national varieties. A list is provided in Figure VII-5. e.g., AVA, ITEA, MVA, MITEA.
- Student Associations (in field). Designed to help students (elementary, secondary or collegiate), these associations help build character, citizenship and develop leadership while at the same time they inject a good measure of "fun" into the process. Usually such associations are intended to be co-curricular in nature - i.e., they reinforce the curriculum, e.g., AIASA, TECA.
- Representative Associations. These groups generally focus on improving education and the teacher's welfare. They serve as the teacher's prime advocate. They exist in local, regional, state and national versions. e.g., MNEA, MFT, MSTA.
- Honor Societies. These associations are designed to enhance the academic/ scholarship ideals of the profession and to recognize exemplary service. e.g., Epsilon Pi Tau, Phi Delta Kappa.
- PTAs. These groups work to improve education by bringing parents, educators and the community together. e.g., local PTAs.

Contact Missouri's IA Supervisor, and/or the IA/ITE/TE departments at the state's higher education institutions, for current addresses for these associations. The Encyclopedia of Associations, usually found in the reference section of local libraries, is another valuable source for these and many other addresses.

Figure VII-5

Selected Professional Associations[1]

AACD	American Association for Counseling and Development
AASA	American Association of School Administrators
AIASA	American Industrial Arts Student Association
ATEA	American Technical Education Association
AVA	American Vocational Association
AVEA	Adult Vocational Education Association
AVEPDA	American Vocational Education Personnel Development Association
AVERA	American Vocational Education Research Association
COE	Council for Occupational Education
CTEA	Council of Technology Education Associations
CTTE	Council on Technology Teacher Education
EEA-SHIP	Educational Exhibitors Association - SHIP
ITEA	International Technology Education Association
ITEA-CS	International Technology Education Association-Council of Supervisors
IVETA	International Vocational Education and Training Association
MEA	Marketing Education Association
MFT	Missouri Federation of Teachers
MITEA	Missouri Industrial Technology Education Association
MSTA	Missouri State Teachers' Association
MNEA	Missouri National Education Association
MVA	Missouri Vocational Association
NAAVBAVE	National Association for the Advancement of Black Americans in Vocational Education
NAITTE	National Association of Industrial, Technical Teacher Educators
NALCDVE	National Association of Large City Directors of Vocational Education
NASCVE	National Association of State Councils of Vocational Education
NASDVE	National Association of State Directors of Vocational Education
NASNSA	National Association of Special Needs State Administrators
NATIE	National Association for Trade and Industrial Education
NATTS	National Association of Trade and Technical Schools
NAVESNP	National Association of Vocational Education Special Needs Personnel
NAVSNTE	National Association of Vocational Special Needs Teacher Educators
NAVTEC	National Association of Vocational Technical Education Communicators
NCCVSO	National Coordinating Council for Vocational Student Organizations
NCLA	National Council of Local Administrators
NETA	National Employment and Training Association
NSBA	National School Boards Association
PTA	Parent Teacher Association
TEAC	Technology Education Advisory Council
TECC	Technology Education for Children Council
TECA	Technology Education Collegiate Association
VEEC	VEEC - Vocational Education Equity Council

---

[1] Basic descriptive information about these and other associations may be obtained from the Encyclopedia of Associations.

6. Resources

________. 1986-1988 Missouri State Plan for Vocational Education. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, Division of Career and Adult Education, 1985

________. Code of Professional Ethics. Columbia, MO: Missouri State Teachers' Association, n.d.

________. Develop an Active Philosophy of Education. Module I-3. Professional Teacher Education Series. Columbus, OH: National Center for Research in Vocational Education, n.d.

________. Directory of Colleges & Universities Offering Degrees in Technology Education/Industrial Arts. Reston, VA: International Technology Education Association, 1986.

________. Encyclopedia of Associations. Detroit, MI: Gale Research Company, 1985, Annually.

________. Handbook for Industrial Arts Education. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, 1977, [IA-2-1].

________. Handbook for Vocational Education. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, Division of Career and Adult Education, 1981.

________. Individual and Organizational Rights and Responsibilities in the Education of Children. Position statement of the National PTA. Washington, DC: National Parent-Teacher Association, 1986.

________. NEA Handbook. Washington, DC: National Education Association, 1986.

________. Recommended Qualifications, Duties and Responsibilities for Administrators of Technology Education (Industrial Arts). Reston, VA: International Technology Education Association, 1985.

________. Secondary Certification Requirements. Jefferson City, MO: Missouri Department of Elementary and Secondary Education, May 1984.

Barnes, James L. Systems of Technology: Organization and Management of Instruction Handbook. Austin, TX: University of Texas-Austin, Center for Occupational Curriculum Development, 1984.

Dennis, Ervin A. (Compiler). Industrial Teacher Education Directory. Cedar Falls, IA: Council on Technology Teacher Education/National Association of Industrial and Technical Teacher Educators, Annually.

Mayfield, W.A. & Payne, Jim. Curriculum Guide for Industrial Technology. Austin, TX: Texas Industrial Arts Association, n.d.

Notes:

Chapter VIII

Helpful Resources

1. Introduction

This chapter consists of four sections. Part 2 indexes the forms found throughout this guide and it provides a place for forms not incorporated into other chapters of this guide. Part 3 contains the Missouri Industrial Technology Education Standards, an overall program quality profile and a sample deficiency correction report. Part 4 presents a set of recommended competencies for the core courses in Missouri's ITE scope and sequence. Finally, Part 5 contains a suggestion form which may be used to provide feedback for future revisions and updates of this Guide. Instructors are encouraged to use this form to enhance the Guide's value!

Notes:

2. Forms

It is recommended that the ITE instructor file originals of the forms your school system uses regularly following this page. In this way all forms will be conveniently available. Also as Missouri's DESE, your system and/or the state's Industrial Arts Supervisor supply additional forms, they should be filed here as well. Forms found in other chapters of this guide are indexed here for convenience.

Figure VII-1

Forms Index

Form Name	Chp/Sec/Page	Purpose
Course of Study: Quality Checksheet	2:6:33	Assess Courses of Study
Sample Major Unit of Instruction Format	2:6:36	Summarize Unit Plan
Major Unit Overview & Analysis Sheet	2:6:37	Analyze & Document Unit Plan
Major Unit of Instruction: Quality Checksheet	2:6:38	Assess Major Unit of Instruction
Sample Self-Instructional Module Format	2:6:42	Organize Self-Instructional Modules
Sample Lesson Plan Format (Detailed)	2:6:51	Organize Lesson Plan
Sample Lesson Plan Format (Simplified)	2:6:58	Organize Lesson Plan
Lesson Plan: Quality Checksheet	2:6:64	Assess Lesson Plan
Performance Objective: Quality Checksheet	2:6:68	Assess Objectives
Sample Equipment Record Card	3:3:24	Record Equipment Data
Student Accident Report Form	3:6:47	Document Accident Facts
Safety Inspection Checklist (Sample Page)	3:6:48	Evaluate Facility Safety
Public Relations Analysis Matrix	3:7:52	Assess Public Relations Activity
ITE Inventory Form	5:5:18	Inventory Equipment
Evaluative Criteria (NSSE)	6:2:5	Assess ITE Programs
Standards & Evaluation Criteria (MO DESE)	6:2:6	Assess ITE Programs
Suggested Local ITE Evaluation Report Format	6:2:10	Summarize Program Evaluation Findings
Program Follow-up Form	6:2:13	Follow-up Evaluation
Sample Rating Scale	6:3:22	Assessing Performance Skill
Affective Performance Objective Format	6:3:23	Assessing Affective Performance
Lesson Presentation Evaluation Sheet	6:4:28	Assess Teaching
Pre-Observation Worksheet	6:4:31	Plan Teaching Evaluation
Formative Observation Form	6:4:32	Assess Teaching
Job Target Sheet	6:4:33	Plan Improvement of Teaching
Summative Evaluation Report	6:4:34	Summarize Teacher Evaluation
MO ITE Standards	8:3:5	Assess Overall Program
ITE Program: Overall Quality Profile	8:3:24	Summarize Program Quality
Deficiency Correction Report	8:3:25	Document Improvement Plan

Figure VII-1, Continued

Forms Index

Form Name	Chp/Sec/Page	Purpose

Course: ____________________

Weekly Instructional Plan

Instructor: __________

Grade: ___ Period: ___ Section: ___

Date/Day	Topic	Activities	Assignments	Instructional Approach

Student Progress Chart

Course: ____________
Grade: __ **Period:** __
Semester: _____

____
____

3. Missouri Industrial Technology Education Standards[1]

Topic 1

Philosophy

Industrial technology education/industrial arts are programs that depend upon a quality statement of philosophy as being critical to the success of the program. It must be written carefully to ensure that the ultimate goal, that is, comprehending our technological culture, is the basis for all content and instructional strategies. The statements contained within this standard topic concern the philosophy of a technology education program. A philosophy is a statement of fundamental beliefs which reflect a value system. It serves as a foundation and framework for all elements of a program.

Fill in marks to indicate assessment: ∇ **not met**, 0 **met**, Δ **exceeded**

1. The philosophical statement is written and on file. (Note: if the response is "no", then standards 2-17 should also be marked "no".) ∇ 0 Δ
2. The philosophical statement is consistent with local, state, and national philosophies of education and of industrial technology education/industrial arts. ∇ 0 Δ
3. The philosophy describes the industrial and addresses the technological nature of society in the past, present, and future. ∇ 0 Δ
4. The philosophy identifies the needs, abilities, and interests of all learners, regardless of race, sex, creed, national origin, or handicapping conditions. ∇ 0 Δ
5. The philosophy addresses the value of a comprehensive industrial technology education/ industrial arts program including: industrial and technological literacy; career orientation, exploration, and preparation; avocational activities; economic concepts; consumer skills; creative talents; personal and social growth; and problem solving skills. ∇ 0 Δ
6. The philosophy encourages development of personal and leadership skills through AIASA or local program student clubs. ∇ 0 Δ
7. The philosophy focuses upon the broad categories of communication, construction, manufacturing, and transportation at all educational levels. ∇ 0 Δ
8. Other teachers, interested in and knowledgeable about industrial technology education/ industrial arts, provide input for the philosophical statement. ∇ 0 Δ
9. Administrators and supervisory personnel responsible for local industrial technology education/industrial arts programs provide input into the philosophical statement. ∇ 0 Δ
10. Students, including local American Industrial Arts Student Association (AIASA) chapter members or local club members, are involved in developing the philosophical statement. ∇ 0 Δ
11. Parents, business and industry representatives, and other consultants are allowed to provide input into the philosophical statement. ∇ 0 Δ

---

[1] The profession is indebted to Dr. Scott Bradley for adapting the national standards for Industrial Arts (Dugger et al., 1980) and for technology education (Dugger et al., 1985) to Missouri's situation, for his research in testing them, and for his permission to use them.

12. The philosophical statement is a basis for program planning. ∇ 0 Δ

13. The philosophical statement is a basis for program development. ∇ 0 Δ

14. The philosophical statement is a basis for program implementation. ∇ 0 Δ

15. The philosophical statement is a basis for program evaluation. ∇ 0 Δ

16. The philosophical statement is reviewed annually. ∇ 0 Δ

17. The philosophical statement is revised, as necessary, on the basis of the annual review. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): -- -- --

Topic 2

Instructional Program

The instructional program in industrial technology education/industrial arts will provide youth with knowledge, skills, and attitudes to intelligently create and control their environment. Such a comprehensive program will need to reflect our rapidly changing technological society. The statements contained within this standard topic concern the instructional program. This program, which reflects the stated philosophy, provides a wide variety of organized experiences for all students. These experiences assist learners in reaching predetermined goals.

Fill in marks to indicate assessment: ∇ not met, 0 met, Δ exceeded

18. Emphasis is placed upon assisting students in developing insight and understanding of our industrial and/or technological society. ∇ 0 Δ

19. Emphasis is placed upon improving student ability to make informed and meaningful occupational/career choices. ∇ 0 Δ

20. Emphasis is placed upon preparing students for entry into specialized technical training and/or advanced professional programs in technology. ∇ 0 Δ

21. Emphasis is placed upon preparing students for entry into advanced trade and industrial, technical, or other advanced education programs. ∇ 0 Δ

22. Emphasis is placed upon preparing students for lifelong learning in a technological society. ∇ 0 Δ

23. Emphasis is placed upon developing student talents, creative abilities, positive self-concepts, and individual potentials related to technology-industrial-technical areas. ∇ 0 Δ

24. Emphasis is placed upon developing student abilities in the safe and proper use of tools, materials, machines, and processes. ∇ 0 Δ

25. Emphasis is placed upon applying tools, materials, machines and processes, and technical concepts safely and efficiently. ∇ 0 Δ

26. Emphasis is placed upon developing student problem- solving and decision-making abilities involving human and material resources, processes and technological systems. ∇ 0 Δ

27. Emphasis is placed upon reinforcing the basic skills and interrelating the content of industrial technology education/industrial arts with other school subjects. ∇ 0 Δ

28. Emphasis is placed upon developing leadership ability, encouraging and promoting responsibility, and developing positive social interaction through AIASA or local program student club. ∇ 0 Δ

29. Program goals are written and are on file. (Note: if the answer is "no", then standards 30-34 are also marked "no".) ∇ 0 Δ

30. Program goals are consistent with local, state, and national standards and emerging developments in industrial technology education/industrial arts. ∇ 0 Δ

31. Program goals are developed with input from teachers, administrators, students, representatives from business and industry, and other consultants, as necessary. ∇ 0 Δ

32. Program goals are written and are on file. ∇ 0 Δ

33. Program goals are utilized by teachers and administrators for planning, implementing, and evaluating courses. ∇ 0 Δ

34. Program goals are reviewed annually and revised when necessary. ∇ 0 Δ

35. Course objectives, written in measurable terms, are presented to students and are kept on file. (Note: if the answer is "no", then standards 36 & 37 are also marked "no".) ∇ 0 Δ

36. Course objectives are utilized by teachers and administrators for planning, implementing, and evaluating course content and instructional methods. ∇ 0 Δ

37. Course objectives are utilized as a basis for developing the industrial technology education/ industrial arts component of the Individualized Education Program (IEP). ∇ 0 Δ

38. Course content is developed from course objectives and utilizes approved curriculum guides, courses of study, and other professional resources. ∇ 0 Δ

39. Course content is offered in the broad categories of communication, construction, manufacturing, and transportation. ∇ 0 Δ

40. Course content is selected to provide for all students. ∇ 0 Δ

41. Course content includes the development of personal and leadership skills through AIASA or local program student club. ∇ 0 Δ

42. Courses in the industrial technology education/industrial education program are sequential, beginning with broad orientation and exploration of subject matter areas, followed by specialized experiences. ∇ 0 Δ

43. Course content represents the state of the art in industry and/or technology. ∇ 0 Δ

44. Course content is organized into course outlines, unit plans, and lesson plans which are on file. ∇ 0 Δ

45. An accurate description for each course is available to all students prior to enrollment. ∇ 0 Δ

46. Course content is reviewed annually and revised when necessary. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): -- -- --

Topic 3

Student Populations Served

All people live and work in our society, which is impacted by technological growth. It is paramount that all students, regardless of future goals, develop a comprehension of industry and technology. The statements contained within this standard topic concern the student populations served. The industrial technology education/industrial arts program may serve all persons, pre-school through adult. Accommodations in the program are made for students with special needs.

Fill in marks to indicate assessment: **∇ not met, 0 met, Δ exceeded**

47. Industrial technology education/industrial arts is offered for a minimum of 18 weeks, 225 minutes per week at each grade level of the junior high/middle school and/or in each course at the senior high school. ∇ 0 Δ

48. School scheduling procedures allow equal opportunities for all students to enroll in technology education courses of their choice. ∇ 0 Δ

49. Students are encouraged to enroll in courses from more that one content category during their total industrial technology education/industrial arts experience. ∇ 0 Δ

50. All students are provided a variety of effective and meaningful learning experiences commensurate with industrial technology education/industrial arts program goals and course objectives. ∇ 0 Δ

51. Students who are academically and/or economically disadvantaged are provided special services and assistance, as required, to enable them to succeed in the industrial technology education/industrial arts. ∇ 0 Δ

52. Students who have physical, mental, and/or emotional impairments are provided special services and assistance, as required, to enable them to succeed in the industrial technology education/industrial arts program. ∇ 0 Δ

53. Students identified as handicapped and requiring additional or modified educational services or materials are enrolled only after the Individualized Education Program (IEP) has been prepared. ∇ 0 Δ

54. Students identified as gifted and/or talented are provided learning activities consistent with their abilities. ∇ 0 Δ

55. Industrial technology education/industrial arts is provided for students, regardless of their cultural differences. ∇ 0 Δ

56. Industrial technology education/industrial arts activities are provided for all students, regardless of their maturity and/or educational level. ∇ 0 Δ

57. Females, as well as males, are encouraged to enroll in industrial technology education/ industrial arts courses, with activities provided on a sex-fair basis. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): -- -- --

Topic 4

Instructional Staff

The instructional staff in industrial technology education/industrial arts will need to constantly study the nature of society and engage regularly in renewal activities. The success of programs in industrial technology education/industrial arts will depend on highly trained and qualified teachers. The statements contained within this standard topic concerns the instructional staff. The instructional staff is responsible for providing the essential components for a quality program. Staff members should meet the highest standards of professional and technical competence.

Fill in marks to indicate assessment: ∇ not met, 0 met, Δ exceeded

58. The industrial technology education/industrial arts teacher possesses a minimum of a baccalaureate degree with a major in industrial arts/technology education from an accredited teacher education program. ∇ 0 Δ

59. The industrial technology education/industrial arts teacher is broadly prepared and certificated in the systems of communication, construction, manufacturing and transportation. ∇ 0 Δ

60. The industrial technology education/industrial arts teacher is technically competent in the assigned teaching area(s). ∇ 0 Δ

61. The industrial technology education/industrial arts teacher is prepared, through preservice/inservice education, to eliminate sex bias and sex-role stereotyping. ∇ 0 Δ

62. The industrial technology education/industrial arts teacher is prepared, through preservice/inservice education, to provide experiences for students with special needs. ∇ 0 Δ

63. The industrial technology education/industrial arts teacher is prepared, through preservice/inservice education, to organize and operate a local AIASA chapter or local program student club. ∇ 0 Δ

64. The industrial technology education/industrial arts teacher, through preservice/inservice education, has knowledge of the legal and liability requirements of classroom/laboratory operation. ∇ 0 Δ

65. The industrial technology education/industrial arts teacher is a member of and actively participates in professional and technical organizations related to industrial technology education/industrial arts. ∇ 0 Δ

66. The industrial technology education/industrial arts teacher has a professional development plan for maintaining and expanding professional and technical teaching competencies. ∇ 0 Δ

67. The industrial technology education/industrial arts teacher participates in a minimum of one technology/industrial arts related inservice activity annually. ∇ 0 Δ

68. The industrial technology education/industrial arts teacher maintains current knowledge in the industrial technology education industrial arts field through activities such as reading professional and technical publications. ∇ 0 Δ

69. The industrial technology education/industrial arts teacher serves as an active member of the school instructional staff, sharing in decision-making processes and participating in program promotion and staff development. ∇ 0 Δ

70. The industrial technology education/industrial arts teacher plans and implements instruction in cooperation with counsellors and other appropriate support personnel. ∇ 0 Δ

71. The industrial technology education/industrial arts teacher has a positive attitude toward the teaching profession and demonstrates a concern for the advancement of industrial technology education/industrial arts. ∇ 0 Δ

72. The industrial technology education/industrial arts teacher adheres to a written code of ethics related to the performance of professional teaching responsibilities. ∇ 0 Δ

73. The industrial technology education/industrial arts teacher demonstrates adequate and appropriate written and oral language skills. ∇ 0 Δ

74. The industrial technology education/industrial arts teacher provides positive leadership in the classroom, the school, and the profession. ∇ 0 Δ

75. The industrial technology education/industrial arts teacher adheres to acceptable school practices regarding personal appearance. ∇ 0 Δ

76. The industrial technology education/industrial arts teacher exhibits good work habits such as safe practices, punctuality, neatness, and attendance that have a positive effect upon the educational environment. ∇ 0 Δ

77. The industrial technology education/industrial arts teacher is sensitive to student needs, recognizes individual student abilities, and practices appropriate teaching methods that motivate students to maximum performance. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): -- -- --

Topic 5

Administration and Supervision

Industrial technology education/industrial arts requires leadership from individuals who comprehend the philosophy and who demonstrate support by helping faculty and support groups to achieve stated goals and objectives. Like the faculty, the supervisor must also continue to grow professionally so that leadership represents the latest thinking in the profession. The statements contained within this standard topic concern the administration and supervision of a technology education program. Administrators and supervisors provide management of and direction for the program. These personnel perform leadership functions that ensure attainment of all program goals.

Fill in marks to indicate assessment: ∇ not met, 0 met, Δ exceeded

78. A minimum of one full-time local industrial technology education/industrial arts supervisor is provided for 25 or more industrial technology education/industrial arts teachers, or for districts with less that 25 industrial technology education/industrial arts, appropriate proportional supervision is provided. ∇ 0 Δ

79. Local supervisors are qualified industrial technology education/industrial arts, have taught industrial technology education/industrial arts for a minimum of three years, and hold an appropriate master's degree. ∇ 0 Δ

80. Local supervisors are certificated industrial technology education/industrial arts teachers and supervisors and have taught for a minimum of three years. ∇ 0 Δ

81. Local supervisors conduct a minimum of one technology education inservice program a year. ∇ 0 Δ

82. A job description which includes the qualifications, duties, and responsibilities of each local industrial technology education/industrial arts supervisor is available. ∇ 0 Δ

83. In addition to local supervision, departmental leadership or management is provided. ∇ 0 Δ

84. A maximum of 20 students are enrolled per teacher, per period of laboratory activity. ∇ 0 Δ

85. A minimum of one non-teaching period for preparation is provided each day. ∇ 0 Δ

86. Time is provided to enable the industrial technology education/industrial arts teacher to organize and advise a local AIASA chapter or local program student club. ∇ 0 Δ

87. Teacher aides or paraprofessionals are provided in classes where enrollment of students with special needs necessitates their assistance. ∇ 0 Δ

88. Supervisors and teachers utilize predetermined standards to plan and organize the industrial technology education/industrial arts program. ∇ 0 Δ

89. Supervisors and teachers utilize predetermined standards to develop short-and-long range program plans. ∇ 0 Δ

90. Provisions are made for teachers to review, develop, and adapt curriculum and instructional materials which are compatible with local and state industrial technology education/industrial arts guidelines. ∇ 0 Δ

91. Supervisors and teachers cooperatively develop specifications for industrial technology education/industrial arts equipment and resource materials. ∇ 0 Δ

92. Supervisors involve teachers in developing specifications for industrial technology education/industrial arts facility design, development, and renovation. ∇ 0 Δ

93. Funds are made available for travel, release time, and substitutes for personnel to participate in inservice professional activities. ∇ 0 Δ

94. Funds are made available for travel, release time, and substitutes for personnel to participate in local, state, and national AIASA or local program student club activities. ∇ 0 Δ

95. Written administrative policies and directives, specifically addressing the operation of the industrial technology education/industrial arts program, are available. ∇ 0 Δ

96. Teachers are visited on a regularly scheduled basis by supervisory personnel. ∇ 0 Δ

97. Any reports required by local, state, and federal agencies are prepared and submitted on schedule. ∇ 0 Δ

98. Accurate financial reports are prepared and submitted on schedule, as required. ∇ 0 Δ

99. Safety reports are prepared and submitted on schedule, as required. ∇ 0 Δ

100. A biographic, academic, and medical profile is maintained on each student enrolled in an industrial technology education/industrial arts course. ∇ 0 Δ

101. Demographic data about all industrial technology education/industrial arts students are available by grade level and by course, including but not limited to course enrollments by racial and ethnic categories, by sex, and by type and number of students with special needs. ∇ 0 Δ

102. Records and related information on equipment, tools, textbooks, and supplies are prepared and made available to appropriate personnel. ∇ 0 Δ

103. Effective, open communication pertaining to all elements in the instructional program is established and utilized consistently among industrial technology education/industrial arts faculty and the rest of the school staff. ∇ 0 Δ

104. Effective, open communication pertaining to all elements in the instructional program is established and utilized consistently among industrial technology education/industrial arts faculty, and administrators, school board members, supervisors, advisory committees. ∇ 0 Δ

105. Effective open communication pertaining to all elements in the instructional program is established and utilized consistently among industrial technology education/industrial arts faculty, and students and parents. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): -- -- --

Topic 6

Support Systems

As our technological society advances, resources and support mechanisms will be in constant change; the industrial technology education/industrial arts program should take advantage of new developments and make the best use of current resources and systems. These support systems include human, physical, and financial resources that are necessary to implement the instructional program. These resources are required to provide a comprehensive, quality industrial technology education/industrial arts program.

Fill in marks to indicate assessment: ∇ not met, 0 met, Δ exceeded

106. Media/instructional resource center services are provided to support the industrial technology education/industrial arts program. ∇ 0 Δ

107. Personnel are available to assist the industrial technology education/industrial arts teacher in serving students with special needs. ∇ 0 Δ

108. Guidance services are provided to assist all students in determining their interests, aptitudes, and abilities; selecting the program that meets their career/avocational goals; and expanding their individual options. ∇ 0 Δ

109. Industrial technology education/industrial arts teachers can obtain interdisciplinary support to assist in achieving program objectives. ∇ 0 Δ

110. Secretarial and clerical services are provided for industrial technology education/industrial arts personnel. ∇ 0 Δ

111. Custodial services are provided, as necessary, to assure safe and sanitary industrial technology education/industrial arts facilities. ∇ 0 Δ

112. Maintenance services are provided, as necessary, to assure safe and functional technology industrial technology education/industrial arts facilities and equipment. ∇ 0 Δ

113. Medical personnel are available, as necessary, to provide instruction and ensure the safety and welfare of students and faculty. ∇ 0 Δ

114. Parents are utilized in achieving program goals and course objectives. ∇ 0 Δ

115. The teacher involves individuals from outside the school community to assist in achieving program goals and course objectives, as necessary. ∇ 0 Δ

116. An industrial technology education/industrial arts advisory committee is established which has representation of both sexes and the racial and ethnic minorities found in the program areas, schools, community, or region which the local advisory committee serves. ∇ 0 Δ

117. The industrial technology education/industrial arts advisory committee includes appropriate representation from the public and private sector and/or business and industry. ∇ 0 Δ

118. The industrial technology education/industrial arts advisory committee is utilized to advise teachers, administrators, and the board of education in planning, developing, implementing, and evaluating the industrial technology education/industrial arts program. ∇ 0 Δ

119. The industrial technology education/industrial arts advisory committee meets at least twice a year. ∇ 0 Δ

120. Industrial technology education/industrial arts laboratories average 2500 square feet or 125 square feet per student, per class, exclusive of ancillary space. ∇ 0 Δ

121. Industrial technology education/industrial arts ancillary space, at an average of 500 square feet for each laboratory, is provided for storage of materials, projects/products, and tools. ∇ 0 Δ

122. Facilities are logically arranged and maintained with consideration given to effective teaching, safety, class management, and economy. ∇ 0 Δ

123. At least 100 square feet of office space per teacher, within or adjacent to the industrial technology education/industrial arts facility, is provided. ∇ 0 Δ

124. Facilities are reviewed annually and modified, as needed, to accommodate changes in the course objectives and changes in technology. ∇ 0 Δ

125. Accessibility for the handicapped is ensured through the elimination of architectural barriers. ∇ 0 Δ

126. Consumable supplies and materials are provided in sufficient quantity and quality to achieve course objectives. ∇ 0 Δ

127. Properly maintained tools, machines, and equipment are available on the basis of their instructional value in fulfilling program goals and course objectives. ∇ 0 Δ

128. Specially designed or modified tools, machines, and equipment are provided for students with special needs, if required. ∇ 0 Δ

129. Books and other instructional materials are supplied in sufficient quantity to meet program goals and course objectives. ∇ 0 Δ

130. Books and other instructional materials contain sex-fair language and images and provide a wide range of role options. ∇ 0 Δ

131. Books and other instructional materials are provided to meet the unique requirements of students with special needs, as necessary. ∇ 0 Δ

132. Resource materials developed or approved by the state education agency are available and utilized at the local level. ∇ 0 Δ

133. The program is supported by an annual written budget based upon the program needs and student enrollment. ∇ 0 Δ

134. Funds are budgeted for equipment maintenance or replacement and for facility improvements to accomplish course objectives. ∇ 0 Δ

135. Budgeted funds for supplies, curriculum and resource materials are expended to fully achieve program goals and objectives. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): __ __ __

Topic 7

Instructional Strategies

Industrial technology education/industrial arts is designed to help students comprehend technological systems and gain the ability to apply what is learned to real-life situations. Instructional strategies must be carefully selected to allow the student to engage in activities which allow them to utilize technological concepts to solve problems. The statements contained within this standard topic concern instructional strategies. These strategies are the methods utilized to deliver instruction and promote student achievement of goals and objective. The technology teacher plans, implements, and evaluates these strategies.

Fill in marks to indicate assessment: **∇ not met, 0 met, Δ exceeded**

136. Teachers plan and prepare written courses of study designed to develop student competencies consistent with program goals and course objectives. ∇ 0 Δ

137. Teachers plan and prepare current lesson plans based upon the course of study and student . needs. ∇ 0 Δ

138. Teachers consider alternatives and select appropriate methods to assist students in meeting course objectives. ∇ 0 Δ

139. Teachers develop and/or obtain appropriate, up-to-date instructional materials. ∇ 0 Δ

140. Teachers plan and provide for evaluating the effectiveness of their instruction. ∇ 0 Δ

141. Teachers provide input to the Individualized Education Program (IEP) committee for handicapped students enrolled in industrial technology education/industrial arts. ∇ 0 Δ

142. Both teacher-centered and student-centered instructional methods are utilized, as necessary. ∇ 0 Δ

143. Instructional methods reflect concepts and operating characteristics of systems and sub-systems, as necessary. ∇ 0 Δ

144. Instructional methods include both group and individual student learning activities, as needed. ∇ 0 Δ

145. Instructional methods promote the development of process skills such as creative and critical thinking, decision-making and problem-solving. ∇ 0 Δ

146. Instructional methods utilized are based upon individual student needs rather than upon the sex of the students. ∇ 0 Δ

147. Instructional methods enhance opportunities for multi-disciplinary learning. ∇ 0 Δ

148. Local program student club or AIASA chapter activities are integrated into planned courses of study and are utilized in conducting classroom and laboratory activities. ∇ 0 Δ

149. Instructional strategies appropriate for serving students with special needs have been identified and incorporated, as needed, into the industrial technology education/industrial arts program. ∇ 0 Δ

150. Student achievement is measured through a variety of testing techniques and other evaluation methods. ∇ 0 Δ

151. Each identified handicapped student enrolled in industrial technology education/industrial arts is evaluated annually through procedures and criteria described in the Individualized Education Program (IEP). ∇ 0 Δ

152. Student leadership skills are developed through a variety of curricular and extracurricular activities. ∇ 0 Δ

153. Student achievement is assessed to make systematic decisions regarding the effectiveness of instructional materials and teaching strategies. ∇ 0 Δ

154. Provisions are made for student input into the evaluation of instructional strategies. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): -- -- --

280

Topic 8

Public Relations

Industrial technology education/industrial arts is comprehensive, ever changing, and complex. The public relations task of the teacher will be a constant challenge. As a critical component of lifelong learning, industrial technology education/industrial arts must be understood and accepted by the general public and key decision makers. The statements contained within this standard topic concern public relations. An informed and involved public is essential to the promotion of an industrial technology education/industrial arts program. Various media are utilized to inform target populations.

Fill in marks to indicate assessment: **∇ not met, 0 met, Δ exceeded**

155. Students promote and support industrial technology education/industrial arts programs through involvement in activities, including AIASA or local program student clubs. ∇ 0 Δ

156. Parents are allowed to support and participate in the industrial technology education/ industrial arts program by functioning as paraprofessionals, advisors, or resource people. ∇ 0 Δ

157. Non-industrial technology education/industrial arts faculty and staff are informed about the industrial technology education/industrial arts program for the purpose of generating support, guidance, and interdisciplinary education opportunities. ∇ 0 Δ

158. Building and district administrators are informed about and participate in the industrial technology education/industrial arts program. ∇ 0 Δ

159. Individuals and organizations outside of the school community are informed of and encouraged to support and participate in the industrial technology education/industrial arts program. ∇ 0 Δ

160. A public information program is utilized to inform and encourage the support of local elected and appointed officials, including school board members. ∇ 0 Δ

161. Local radio and television, as available, are utilized to promote the industrial technology education/industrial arts program activities and accomplishments. ∇ 0 Δ

162. Articles describing unique activities and accomplishments of the industrial technology education/industrial arts program are prepared and published in the local news media, as necessary. ∇ 0 Δ

163. Printed material (handbooks and brochures) describing the industrial technology education/ industrial arts program, goals, objectives, and policies are prepared and utilized. ∇ 0 Δ

164. Articles describing industrial technology education/industrial arts program activities and accomplishments are prepared and published in local, state, and national professional publications. ∇ 0 Δ

165. Media events, including open houses, exhibits, displays, presentations, demonstrations, and industrial technology education/industrial arts week activities are utilized to promote the program. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): -- -- --

Topic 9

Safety and Health

The goals of industrial technology education/industrial arts will require that laboratories be designed to accommodate tools, equipment, materials and unique instructional strategies that represent today and the future. Safety and health must remain a high priority as laboratories are designed and re-designed to accommodate change to reflect new technologies. The statements contained within this standard topic concern safety and health. A comprehensive safety and health program is essential to the success of a quality industrial technology education/industrial arts program. The program provides for a safe environment and promotes lifelong attitudes and practices regarding safety and health.

Fill in marks to indicate assessment: ∇ not met, 0 met, Δ exceeded

166. Teachers prepare a written plan for comprehensive safety and health program. ∇ 0 Δ

167. Administrative personnel provide input for and approval of the safety and health program. ∇ 0 Δ

168. Community, resources, including the industrial technology education/industrial arts advisory committee, provide input to the safety and health program. ∇ 0 Δ

169. Local, state, and national safety and health literature and regulations are utilized in planning the safety and health program. ∇ 0 Δ

170. Safety and health information is included in instruction for all laboratory activities. ∇ 0 Δ

171. Teacher and student activities reinforce safety and health instruction. ∇ 0 Δ

172. Safety and health instruction is adapted to individual student needs. ∇ 0 Δ

173. Safety and health practices are monitored continuously and reviewed annually by the teacher. ∇ 0 Δ

174. Local administrators assess and make recommendations for the improvement of the safety and health program. ∇ 0 Δ

175. Proper authorities, external to the school, inspect periodically and report on the safety and health program. ∇ 0 Δ

176. Students demonstrate acceptable knowledge, skills, and attitudes of safety and health practices and rules through written and performance tests, and in-class behavior. ∇ 0 Δ

177. Teachers and administrators review each recorded accident and all unsafe practices to correct deficiencies. ∇ 0 Δ

178. Classroom and laboratory facilities meet safety and health laws and regulations. ∇ 0 Δ

179. Safety zones and aisles are properly marked. ∇ 0 Δ

180. Lavatory facilities for both sexes are provided near or in the industrial technology education/industrial arts laboratory. ∇ 0 Δ

181. Lighting is appropriate for the activities performed within the facility. ∇ 0 Δ

182. Proper exhaust system equipment which removes fumes, chips, and dust from the building is provided, as needed. ∇ 0 Δ

183. Noise levels within the laboratory do not exceed acceptable limits. ∇ 0 Δ

184. Proper equipment is provided to heat, cool, or ventilate all instructional and ancillary areas, as needed. ∇ 0 Δ

185. Approved safe cabinets, containers, or rooms are provided to store flammable and corrosive materials. ∇ 0 Δ

186. Special safety and health accommodations are provided for students with special needs, as required. ∇ 0 Δ

187. Floors and all other surfaces are kept free of waste material, grease, and obstructions, as needed. ∇ 0 Δ

188. Floors have non-skid surfaces, with special application on machine-operator work areas. ∇ 0 Δ

189. Each laboratory with powered equipment has the equivalent of one easily accessible emergency disconnect switch (panic button) per perimeter wall. ∇ 0 Δ

190. Fire extinguishers of the correct class are provided in appropriate locations. ∇ 0 Δ

191. A first-aid kit and related emergency supplies are provided in accordance with local regulations. ∇ 0 Δ

192. Equipment which satisfies state and federal regulations is selected on the basis of the ability to meet program objectives safely. ∇ 0 Δ

193. Machines and tools are placed, mounted, if necessary, and arranged in a safe and functional manner. ∇ 0 Δ

194. All machines and power tools are provided with approved commercial guards and safety devices. ∇ 0 Δ

195. Safety guards remain in place, except when the machine is disconnected for cleaning, repair, or adjustment. ∇ 0 Δ

196. Any machine or tool found to be unsafe is removed from service and marked accordingly. ∇ 0 Δ

197. Color-coding schemes for safety purposes are used throughout the industrial technology education/industrial arts laboratory. ∇ 0 Δ

198. Conveniently located magnetic control switches and/or control boxes and braking devices are provided for appropriate machines. ∇ 0 Δ

199. Lockable master switch boxes are located in each industrial technology education/industrial arts laboratory. ∇ 0 Δ

200. State or federally approved eye protection devices are required of all persons exposed to conditions which may cause eye injury. ∇ 0 Δ

201. State or federally approved ear protection devices are required of all persons exposed to conditions which may cause ear damage. ∇ 0 Δ

202. State or federally approved respiratory protection devices are required of all persons exposed to conditions which may cause respiratory problems. ∇ 0 Δ

203. State or federally approved head protection devices are required of all persons exposed to conditions which may cause head injury. ∇ 0 Δ

204. Specially adapted personal protection devices are available for and used by students with special needs, as needed. ∇ 0 Δ

205. Teachers and students wear appropriate clothing when exposed to conditions which warrant such protection. ∇ 0 Δ

206. Personal protection devices requiring sanitation are sanitized after each use. ∇ 0 Δ

207. Corrective and preventive maintenance is performed within a reasonable time following written notification to the appropriate administrator. ∇ 0 Δ

208. Lesson plans documenting provision for safety and health instruction are on file. ∇ 0 Δ

209. Results of written and performance tests and observations documenting student safety and health knowledge, attitudes, and skills are on file. ∇ 0 Δ

210. Inspection, maintenance, repair, and replacement records are current and on file, as required. ∇ 0 Δ

211. Records of each accident and the follow-up procedures taken are on file. ∇ 0 Δ

212. Emergency procedures for responding to accidents are posted and on file. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): __ __ __

Topic 10

Evaluation Process

Industrial technology education/industrial arts programs will constantly change to reflect the society. Program teachers and others will need to apply the evaluation process on a regular basis to assess program progress. The statements contained within this standard topic concern the evaluation process. All elements of the program are systematically and continuously assessed and compared to desired standards. The standards in this document serve as bases for the evaluation of these programs.

Fill in marks to indicate assessment: ∇ not met, 0 met, Δ exceeded

213. Instruments, based upon the standards contained in this document, are designed and/or selected to obtain valid and reliable information. ∇ 0 Δ

214. Instruments are administered annually to collect valid and reliable data on selected aspects of industrial technology education/industrial arts program. ∇ 0 Δ

215. Data on the total industrial technology education/industrial arts program are collected at least once every five years. ∇ 0 Δ

216. Data are collected, as necessary, for compliance with accrediting agencies, and state and federal mandates. ∇ 0 Δ

217. Valid procedures are utilized to analyze data and identify discrepancies between the current program and the standards in this document. ∇ 0 Δ

218. Findings from the data collection and analysis efforts are disseminated to the evaluator, the evaluate, and to appropriate decision makers. ∇ 0 Δ

219. Discrepancies between program status and standards are reported to appropriate decision . makers. ∇ 0 Δ

220. Recommendations for correcting deficiencies are reported to appropriate decision makers. ∇ 0 Δ

221. A written course of action is developed, with priorities determined, actions implemented, and results assessed for effectiveness in dealing with each deficiency. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): -- -- --

Developing the Overall Profile[1]

Whoever is conducting the ITE program, or program component, assessment must come to a decision whether each standard in each topic has been met, was exceeded, is deficient, or is not applicable. These decisions may be made either individually or by a team. If the standard was not met, the inverted triangle is shaded. If the standard was exceeded, the upright triangle is shaded, and if the standard was met but not exceeded, the central oval is to be shaded. No discussion is necessary at this time. A quick decision should be made regarding each statement and comment. If in a team situation, it is recommended that discussion should be used only if the comments and judgments are divergent or are in error. This entire process should last only 45 minutes for each of the ten standard topics.

After each standard in the topic is completed a summary for that topic is generated. The results of these summaries are transferred to the ITE Program Overall Quality profile sheet on the following page. The profile provides a visual format to illustrate the extent to which the program meets the standards. The profile can be used for presentations to the advisory council, teachers, the school administration, and the Board of Education. As deficiencies are corrected, the profile can be adjusted to show progress.

Identifying Means to Correct Deficiencies[1]

One of the most difficult tasks in using the standards is to develop the means by which the identified deficiencies are to be corrected. To develop a deficiency correction report for each standard statement which is below standard is a time consuming and arduous endeavor. Therefore, it is recommended that whenever possible standard topics and sub-topics be grouped together into a single deficiency correction report. This will reduce the effort required and it groups together a common set of tasks to overcome related deficiencies. This method will also provide long-range and short-range goals to be undertaken to alleviate the deficiency.

A deficiency correction report, a sample is provided in Figure VIII-2, is a plan for overcoming the deficiency. As such it should be written in behavioral terms. Several short-term and long-term goals should be identified with specific target dates given for each goal. It is also very important to specify who is to do the work required. Each goal and respective target date will be used to formulate the plan of action.

This plan must also include specific cost estimates for the work needed to overcome each deficiency. The deficiency correction report then includes:

- The topic and standards which need attention.

- The goals, stated in behavioral terms, that are appropriate to address the weaknesses and that specify:
  - an observable outcome
  - conditions of performance
  - criteria for judging success

- A plan of action for addressing the weaknesses. This plan includes:
  - who is to do the work
  - task(s) to be accomplished
  - timelines to be met
  - resources to be allocated

- Administrative approval

Such a systematic approach is realistic and will be appreciated by the Board of Education and school administration. It is recommended that outside consultants who are familiar with contemporary national and state trends in industrial technology education/industrial arts be employed to assist in the activity towards correcting key deficiencies.

---

[1] Adapted with permission from Walencik, Vincent J. User's Manual: Standards for Industrial Arts in New Jersey.

Figure VIII-2

Industrial Technology Education Program Overall Quality Profile

Record each standard topic's count of standards met and exceeded in its bar chart.

Standard Topic 1: Philosophy

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		8.5		17

Standard Topic 2: Instructional Program

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		14.5		29

Standard Topic 3: Student Populations Served

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		5.5		11

Standard Topic 4: Instructional Staff

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		10		20

Standard Topic 5: Administration and Supervision

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		14		28

Standard Topic 6: Support Systems

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		15		30

Standard Topic 7: Instructional Strategies

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		9.5		19

Standard Topic 8: Public Relations

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		5.5		11

Standard Topic 9: Safety and Health

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		23.5		47

Standard Topic 10: Evaluation Process

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		4.5		9

Figure VIII-3

Deficiency Correction Report

School: ____________ Reported by: ____________ Date: ________

____

____

Topic: ____________ Page No.: ____________ Standard No: ____

Statement of Deficiency:

Priority for Correction: High Medium Low (circle one)

Person(s) Responsible for Correcting Deficiency: ____________

____

Plan for Overcoming Deficiency:

Resources Required:

Estimated Cost $__________

Estimated Completion Date: __________ Date Standard Met: __________

Notes:

4. Recommended Competencies for ITE Core Courses

The following pages contain suggested major units of instruction, content, and competencies for the five core courses of ITE's scope and sequence.

- Introduction to Technology/Industrial Technology
- Exploration of Technology/Industrial Technology
- Introduction to Communication Technology
- Introduction to Energy & Power Technology
- Introduction to Materials & Processing Technology

INTRODUCTION TO TECHNOLOGY/INDUSTRIAL TECHNOLOGY

Suggested Major Units of Instruction: Introduction to Technology/Industrial Technology

1. Working With Technology
2. Overview of Technology
3. Communication Technology
4. Energy & Power Technology
5. Materials & Processing Technology
6. Leadership Roles in Technology

Suggested Content Outline: Introduction to Technology/Industrial Technology

1. Working With Technology
    - Information Accessing/Retrieval
    - Information Processing
    - Information Storage
    - Systems Analysis
    - Systems Design
    - Measurement, Precision and Standardization

2. Overview of Technology
    - Technology Outside of Industry
        - Medical
        - Military
        - Recreational
        - Agricultural
    - Components of Industrial Technology
        - Energy & Power Technology
        - Communication Technology
        - Materials & Processing Technology
    - Impacts of Technology
        - Environmental
        - Psychological
        - Sociological
        - Economic
    - Evolution of Technology
    - Relationship between Technology & Science
    - Relationship between Technology & Industrial Technology
    - Innovation and Invention
    - Technology Assessment
    - Technology Forecasting
    - Careers
    - Safety

3. Communications Technology
    - Communications Fundamentals
    - Engineering Graphics/Drafting
    - Graphic Arts
    - Photographic Communication
    - Design and Communication
    - Electronic Communication
    - Applications (Desktop publishing, printing, CAD, satellite, photography, video-recording. . .)

4. Energy & Power Technology
    - E & P Fundamentals
    - Energy Systems
    - Power Systems
    - Transportation Systems
    - Instrumentation & Control Systems
    - Electric/Electronic Systems
    - Applications (Engines, robots, space travel, computers, electronics. . .)

5. Materials & Processing Technology
    - M & P Technology Fundamentals
    - Manufacturing
    - Construction
    - Materials Science
    - Enterprise and Entrepreneurship
    - Labor and Management
    - Applications (Mass production, residential construction, materials testing. . .)

6. Leadership Roles in Technology
    - Individual Leadership
    - Group Leadership
    - Student Organization Activities

Suggested Competencies: Introduction to Technology/Industrial Technology

1. Working With Technology--The student will be able to:

1. Identify the components of common technological systems and depict their relationships by means of a sketch.
2. Design technological systems by assembling components of other systems into a new configuration that meets the design specification.
3. Use information accessing and retrieval methods important in the technological world.
4. Demonstrate technological information storage procedures using available methods.
5. Employ technological information processing such as charting and critical thinking.
6. Apply concepts and skills related to technological problem-solving in arriving at solutions to assigned problems.
7. Demonstrate an understanding of hypothesis generation, testing and critical thinking as they apply to technological problem-solving.
8. Enhance problem-solving and creative thinking ability through technological activities and experiences which stimulate thinking and encourage ideation.
9. Fabricate and test original design solutions to technological problems.

2. Overview of Technology--The student will be able to:

1. Identify technological arenas outside of industry (such as medical, military, recreation and agriculture).
2. State that industrial technology is one of many components of technology.
3. List the major components of industrial technology.
4. Identify the main components, and sketch their relationships, of communication technology.
5. Identify the main components, and sketch their relationships, of energy & power technology.
6. Identify the main components, and sketch their relationships, of materials & processing technology.
7. List four major categories (environmental, psychological, sociological, economic) of technology's impact on our culture.

8. Describe positive and negative examples of technology's impact in each of the four categories of cultural impact.
9. Describe the relationship between technology & science.
10. Trace the historical evolution of selected major technological developments.
11. Explain why and how key technological developments occurred.
12. Employ technology assessment procedures in developing case studies of key technologies.
13. Project realistic futures using technology forecasting techniques.
14. Classify and identify occupations in each major technological arena.
15. Assess his/her abilities and interests as they relate to careers in technology.
16. Identify major groups of occupations in industrial technology.
17. Discuss and interpret the responsibilities of careers in industrial technology.
18. Operate basic tools and power equipment safely and effectively.
19. Reinforce key concepts and skills learned in other subjects by applying them in technological situations.

3. Communications Technology--The student will be able to:

1. Describe the role of communication technology as an industry.
2. Describe the relationship of communication technology to energy & power and materials & processing technologies.
3. Describe the communication process and its steps and variables.
4. Produce freehand technical drawings.
5. Apply accepted lettering practices and styles to drawings they have generated.
6. Describe objects using pictorial methods.
7. Construct multiview projections with instruments.
8. Show object and feature sizes using standard dimensioning practice.
9. Produce products using conventional image generation methods.
10. Operate standard reproduction and duplicating equipment.
11. Describe the types and uses of visual communications equipment.
12. Produce basic photographic negatives and prints.
13. Apply the basic principles of design in designing a product to meet a specified need.
14. Employ computer software to design and make drawings.
15. Use data base software to assist in collecting, storing and retrieving information for technological applications.
16. Use basic communication technology tools, materials and processes.
17. Apply the principles of engineering graphics in producing basic drawings.
18. Apply the principles of architectural drawing in producing construction drawings.
19. Apply the principles of graphic communication in generating media products.
20. Apply the principles of electronic communication to transfer information between places.
21. Demonstrate an understanding of, and capability with, selected applications of communication technology by producing projects/conducting experiments involving such technologies as CAD, photography, printing, desktop publishing, video-recording. . . .

4. Energy & Power Technology--The student will be able to:

1. Describe the elements of energy & power technology.
2. Describe the relationship of energy & power technology to communication and materials & processing technologies.
3. Describe the components of energy systems.
4. Describe the components of power systems.
5. Describe the components of instrumentation and control systems.
6. Describe the components of electric/electronic systems.
7. Use basic energy & power technology tools, materials and processes.
8. Manipulate common test instruments utilized in energy/power applications.
9. Experiment with conventional and alternate sources of energy.
10. Demonstrate the principles and operation of internal/external combustion engines.

11. Use apparatus and devices that demonstrate the generation, conversion, and control of mechanical, electrical, and pneumatic-hydraulic power.
12. Apply the principles of mechanical, electrical and pneumatic/hydraulic power transmission in solving assigned problems.
13. Construct static or working models or examples of devices that control energy conversion.
14. Construct static or working models that demonstrate devices or systems that convert energy.
15. Utilize computers for the collection and analysis of data relevant to energy technology.
16. Compare transportation systems that move people and materials by land, sea, air, and space.
17. Plan and implement the controlled movement of robots.
18. Use instrumentation with computers to monitor data-based systems.
19. Describe the types and uses of energy & power technology equipment.
20. Demonstrate an understanding of, and capability with, selected applications of energy & power technology by producing projects/conducting experiments involving such technologies as energy conversion power transmission, electricity/electronics, instrumentation, control. . . .

5. Materials & Processing Technology--The student will be able to:

1. Describe the role of materials & processing technology as an industry.
2. Describe the components of manufacturing systems.
3. Describe the components of construction systems.
4. Describe the key elements of materials science.
5. Explain the steps involved in establishing an enterprise.
6. Describe the role and operation of labor and management within American enterprise.
7. Differentiate among the characteristics of craft, individual, mass and continuous production.
8. Produce products using conventional materials processing methods.
9. Describe the types and uses of materials & processing equipment.
10. Describe the relationship of materials & processing technology to energy & power and communication technologies.
11. Use basic materials & processing technology tools, materials and processes.
12. Apply the principles of materials processing in producing basic products.
13. Apply the principles of materials processing in constructing basic structures.
14. Apply the principles of materials processing in testing materials characteristics and properties.
15. Operate standard materials processing equipment.
16. Describe the types and uses of materials & processing technology equipment.
17. Apply industrial organization and management systems by planning, organizing and controlling production process.
18. Research the transformation of raw materials into finished products.
19. Demonstrate techniques and processes used in automated production systems.
20. Use computers in planning, production, quality control.
21. Use accepted material testing procedures to ascertain the properties and characteristics of common materials.
22. Evaluate products/processes using accepted standards.
23. Apply maintenance and servicing techniques.
24. Demonstrate an understanding of, and capability with, selected applications of materials & processing technology by producing projects/conducting experiments involving such technologies as materials testing, manufacturing, construction. . . .

6. Leadership Roles in Technology--The student will be able to:

1. Define key elements of individual and group leadership.
2. Apply leadership processes to student organization activity.
3. Analyze recent in-class events and explain why they worked/didn't work in terms of leadership activity.
4. Describe the objectives of student organization activity.
5. Use student organization activity to reinforce learning about industrial technology.

EXPLORATION OF TECHNOLOGY/INDUSTRIAL TECHNOLOGY

Suggested Major Units of Instruction: Exploration of Technology/Industrial Technology

1. Overview of Industrial Technology
2. Technological Procedures
3. Exploring Communication Technology
4. Exploring Energy & Power Technology
5. Exploring Materials & Processing Technology
6. Technology and Careers
7. Leadership Roles in Technology

Suggested Content Outline: Exploration of Technology/Industrial Technology

1. Overview of Industrial Technology
   - Energy & Power Technology
   - Materials & Processing Technology
   - Communication Technology
   - Scientific Foundations of Technology
     - Energy Conservation
     - Molecular Structure of Materials
     - Nature of Electricity
     - Light
     - Time
     - Sound
     - Thermal Expansion
     - Scientific Notation
   - Industrial Technology Systems
     - Relationships of Industrial Technology to Technology
     - Interrelationships among M & P, Communication, and E & P Technologies

2. Technological Procedures
   - Information Accessing/Retrieval
   - Information Processing
   - Data Analysis
   - Graphing Data
   - Information Storage
   - Black Box Approach
   - Brainstorming
   - Systems Analysis
   - System Design
   - Using Computers to Calculate
   - Data Acquisition
   - Group Methods of Problem-Solving

3. Exploring Communication Technology
   - Reinforcement of Fundamentals
   - Drafting
   - Photography
   - Electronic Communication
   - Graphic Arts
   - Applications -(Computer messaging, telephone, satellite communications, video-recording, photography, desktop publishing, CAD...)

4. Exploring Energy & Power Technology
   - Reinforcement of Fundamentals
   - Instrumentation & Control Systems
   - Applications (Power transmission, energy conversion. . .)
   - Transportation Systems

5. Exploring Materials & Processing Technology
    - Reinforcement of Fundamentals
    - Manufacturing
    - Construction
    - Materials Science
    - Applications (Mass production, Materials processing, materials testing. . .)

6. Technology and Careers
    - Career and Technology Clusters
    - Elements of Career Choice
    - Preparing for a Career

7. Leadership Roles in Technology
    - Individual Leadership
    - Group Leadership
    - Student Association Activities

Suggested Competencies: Exploration of Technology/Industrial Technology

1. Overview of Industrial Technology--The student will be able to:

1. Name and describe the components of industrial technology.
2. Give examples that illustrate the relationship between industrial technology and technology.
3. Describe major interrelationships among communication, energy & power and materials & processing technologies.
4. Name and describe the components, tools, machines, materials and processes of communication technology.
5. Name and describe the components, tools, machines, materials and processes of energy & power technology.
6. Name and describe the components, tools, machines, materials and processes of materials & processing technology.
7. Demonstrate understanding of the scientific foundations of technology by explaining the technological applications of energy conservation, the molecular structure of materials, the nature of electricity, light, sound and thermal expansion.
8. Use scientific notation in the solution of technological problems.

2. Technological Procedures--The student will be able to:

1. Employ reference manual, computer and microform information accessing/retrieval processes to secure needed information.
2. Analyze unfamiliar technological systems and sketch possible configurations.
3. Design and sketch the configuration of systems that meet assigned objectives.
4. Store information using computer, manual and mechanical methods.
5. Process information related to technological problems using manual, graphic and electronic means.
6. Apply the "Black Box" approach to technological systems.
7. Use the "Brainstorming" process to generate alternative solutions to technological problems.
8. Analyze technological data using appropriate computer programs.
9. Use computer data bases to retrieve information and generate reports.
10. Depict data using key graphing and charting techniques.
11. Use the computer to electronically collect data from a technological system.
12. Employ group methods of problem solving to address challenges too complex for an individual.
13. Demonstrate an awareness and understanding of hypothesis generation, testing and critical thinking by conducting and documenting an experiment.

14. Describe the major categories of computer usage in industry.
15. Use a selected computer language to solve a technological problem.
16. Employ computer-aided-design/drafting (CAD) hardware and software to generate engineering graphics.
17. Use computers to simulate industrial applications/processes.

3. Exploring Communication Technology--The student will be able to:

1. Apply previously learned communication technology processes (drafting, CAD, graphic arts...) to the solution of higher level problems/assignments.
2. Describe the relationship of communication to the development of a technological society.
3. Define and explain the key terms associated with communication technology.
4. Define the basic concepts related to drafting as the language of industry.
5. Produce freehand drawings.
6. Identify drafting tools, equipment, and materials and demonstrate their proper use.
7. Demonstrate knowledge of drafting processes and techniques including lettering, types of lines, types of drawings, and scaling.
8. Construct multiview projections using conventional drafting instruments.
9. Describe object and feature sizes and characteristics by dimensioning and notation practices.
10. Use standards, symbols and conventions to detail drawings.
11. Explain the relationship between design and drafting work as a means of graphic communication.
12. Apply the principles of composition to design a graphic product.
13. Compare and contrast the major types of printing processes.
14. Demonstrate the safe use of graphic arts equipment, tools, materials and processes
15. Operate standard office/commercial duplicating equipment.
16. Produce graphic products using relief, planographic, intaglio, stencil, photographic and electrostatic methods of image transfer.
17. Employ appropriate finishing and binding techniques to complete a product.
18. Define and explain the key terms associated with conventional and video photography.
19. Demonstrate and explain the parts of an adjustable camera.
20. Explain the major chemical processes involved in graphic arts and photography.
21. Plan, produce, and evaluate the technical and communication quality of black and white photographic prints.
22. Demonstrate an understanding of, and capability with, selected applications of communication technology by producing projects/conducting experiments involving such technologies as CAD, computer messaging, satellite communication,photography, printing, desktop publishing, video-recording. . .

4. Exploring Energy & Power Technology--The student will be able to:

1. Apply previously learned energy & power technology processes (energy conversion, power transmission, instrumentation, control...) to the solution of higher level problems/assignments.
2. Describe the relationship of energy to the development of a technological society.
3. Identify energy & power technology tools, equipment, and materials and demonstrate their proper and safe use.
4. Define and explain the key terms associated with energy & power technology.
5. Describe and sketch basic instrumentation and control systems as used in industry and the home.
6. Explain and illustrate the various types and roles of transportation systems.
7. Apply basic concepts of physics and chemistry in explaining the operation of energy & power systems.
8. Describe the characteristics and limitations of available energy resources.
9. Explain the basic types of energy conversions.
10. Define and give examples of each form of energy.
11. Provide examples of the wise and unwise use of energy by industry and individual consumers.
12. Use basic energy & power measuring instruments.

13. Identify alternative energy sources and appropriate uses for them.
14. Explain how energy sources are used in homes, businesses, and transportation.
15. Identify and describe the basic categories of power transmission systems.
16. Explain and illustrate internal and external combustion principles.
17. Define the basic electrical units and terms.
18. Explain and apply basic electrical laws.
19. Explain the principles of DC and AC current.
20. Differentiate among the various types of electric motors and their applications.
21. Interpret general schematic diagrams.
22. Describe basic electronic functions (current, voltage, capacitance, resistance, electromagnetism. . .) in terms of physics.
23. Describe control systems for energy conversion and power transmission systems.
24. Describe the importance of following code/regulations in the installation of electrical wire and components.
25. Experiment with variables in the operation of energy & power systems.
26. Explain the need for systematic and safe procedures in setting up experimental circuits and servicing equipment.
27. Identify and demonstrate the sources of electricity.
28. Illustrate examples of significant contributions that have resulted from space technology.
29. Trace fuel and ignition systems in small engines.
30. Troubleshoot and adjust small engines.
31. Demonstrate safe working habits involving energy & power systems.
32. Demonstrate an understanding of, and capability with, selected applications of energy & power technology by producing projects/conducting experiments involving such technologies as energy conversion, computer control, instrumentation, power transmission, alternative energy, robotics, electricity/electronics, automobile, aircraft and industrial systems. . . .

5. Exploring Materials & Processing Technology--The student will be able to:

1. Apply previously learned materials & processing technology processes (manufacturing, construction, materials testing...) to the solution of higher level problems/assignments.
2. Describe the relationship of materials processing to the development of a technological society
3. Define and explain the key terms associated with materials & processing technology.
4. Identify materials processing tools, equipment, and materials and demonstrate their proper and safe use.
5. Describe the components of materials & processing technology.
6. Describe the components of manufacturing technology.
7. Describe the components of construction technology.
8. Describe the components of materials science technology.
9. Apply basic concepts of physics and chemistry in explaining the operation of materials processing systems.
10. Describe the characteristics and limitations of available material resources.
11. Differentiate among, and give examples of, individual, craft, mass and continuous production, construction, extraction and servicing.
12. List, define and give examples of the categories of materials (metals, cellulose, synthetic, ceramic. . .).
13. Identify and use different kinds of material appropriately.
14. Develop and read a working drawing to fabricate a product.
15. Select and appropriately use various fastening methods.
16. Apply basic wood processing in laboratory activities.
17. Apply basic metal processing in laboratory activities.
18. Apply basic ceramic processing in laboratory activities.
19. Apply basic plastics processing in laboratory activities.
20. Finish products with industrial techniques.
21. Select and appropriately use consumer goods related to industrial materials.

22. Evaluate methods and processes employed by industry to produce material products and conserve our resources.
23. Compare and evaluate the various characteristics of good design used in the production of consumer and industrial goods.
24. Investigate and experiment with basic materials processes used in separating, combining, forming and/or conditioning a product.
25. Experiment with variables in the operation of materials processing systems.
26. Identify the common materials, their properties, and how they are refined.
27. Describe the principles and techniques of heat treatment and metallurgy.
28. Perform precision measurement and layout using customary and metric systems.
29. Demonstrate knowledge of basic manufacturing processes by organizing and producing a quantity of products.
30. Identify the sources of raw materials used in industry.
31. Use working drawings and bills of material in the planning of laboratory activities.
32. Explain, and provide some examples of, the relationship between supply and demand.
33. Design and engineer basic production jigs, fixtures and facilities.
34. Describe the need for, and methods of, production control.
35. Provide examples of important the safety measures necessary in manufacturing plants.
36. Demonstrate pride in workmanship.
37. Demonstrate an understanding of, and capability with, selected applications of materials & processing technology by producing projects/conducting experiments involving such technologies as CAD/CAM, manufacturing, construction,materials testing. . . .

6. **Technology and Careers--The student will be able to:**

1. Identify and describe major examples of career and technology clusters.
2. Explain the key elements in making a tentative career choice.
3. Describe various routes to preparing for selected careers.
4. Provide examples of different levels and types of occupations within any career cluster.
5. Use guidance materials in explaining the data/people/things differences among selected occupations.
6. Describe the different types of computer-related careers in industry.
7. Describe the range and nature of careers, and the ways to prepare for them, in drafting, graphic arts, photographic and communication related occupations.
8. Describe the range and nature of careers, and the ways to prepare for them, in energy & power technology related occupations.
9. Describe the range and nature of careers, and the ways to prepare for them, in materials processing, manufacturing, construction and related occupations.
10. Identify major factors important to informed and meaningful occupational and educational choice.
11. Demonstrate positive attitudes regarding the value and dignity of work.

7. **Leadership Roles in Technology--The student will be able to**

1. Knowledgeably participate in group discussion involving industrial technology.
2. Demonstrate confidence in role playing and group discussion.
3. Take responsibility for planning their own work.
4. Provide leadership and/or perform officer duties in projects/activities requiring group work.
5. Take an active role in guiding student organization work towards successful completion.
6. Demonstrate effective citizenship characteristics by employing accepted procedures within organizations.

INTRODUCTION TO COMMUNICATION TECHNOLOGY

Suggested Major Units of Instruction: Introduction to Communication Technology

1. Communication Technology Overview
2. Technological Procedures
3. Communication Technology Fundamentals
4. Engineering Graphics & Design Fundamentals
5. Graphic Communications (Print) Fundamentals
6. Photographic Communication Fundamentals
7. Electronic Communication Fundamentals
8. Communication Technology Applications
9. Careers in Communication Technology
10. Leadership Roles in Technology

Suggested Content Outline: Introduction to Communication Technology

1. Communication Technology Overview
   - Communication Process
   - Communication Systems
     - Man <---> Machine
     - Machine<---> Machine
   - Components of Communication Systems
   - Languages & Symbols of Communication
   - Interface to Energy & Power Technology
   - Interface to Materials & Processing Technology
   - Communication Technology Impacts
     - Economic
     - Environmental
     - Psychological
     - Sociological
   - Safety
   - Scientific Foundations of Communication Technology
     - Chemistry
     - Physics
     - Math

2. Technological Procedures
   - Information Accessing/Retrieval/Storage
   - Information Processing
   - Information Reporting
   - Problem-solving Processes
   - Systems Analysis & Design
   - Technology Assessment

3. Communication Technology Fundamentals
   - Idea Generation
   - Image Generation
   - Image Processing
   - Transmission
     - Light
     - Audio
     - Electrical
     - Electronic
     - Graphic
     - Tactile

- Reception/Decoding
- Feedback & Evaluation
- Information Storage Methods
- Data Communications

4. Engineering Graphics & Design Fundamentals
    - Drafting Techniques
    - Standards and Symbols
    - Basic Descriptive Geometry
    - CAD
    - Architectural Drafting
    - Mechanical Drafting
    - Design
    - Print Reading
    - Sketching
    - Print Reproduction

5. Graphic Arts (Print) Technology Fundamentals
    - Graphic Arts
    - Copy generation
    - Printing
    - Binding and Finishing

6. Photographic Communication Fundamentals
    - Exposing Film
    - Processing Techniques
    - Line Copy
    - Continuous Tone Copy
    - Color/BW

7. Electronic Communication Fundamentals
    - Radio Frequency
    - Data Communications
    - Computer Graphics
    - Laser/Fiber Optics

8. Communication Technology Applications
    - Broadcasting
        - Radio
        - Television
    - Newspaper & Magazine (Print) Publishing
    - Desktop Publishing
    - Video Recording
    - Satellite

9. Careers in Communication Technology
    - Personal Assessment
    - Career and Technological Trends
        - Manufacturing
        - Service
        - Sales
    - Employability Skills

10. Leadership Roles in Technology
    - Individual Leadership
    - Group Leadership
    - Student Organization Activities

Suggested Competencies: Introduction to Communication Technology

1. Communication Technology Overview--The student will be able to:

1. Describe and illustrate the communication process, its components and its key variables.
2. Provide examples of the major types of communication systems (Man <---> Machine, Machine<---> Machine . . .).
3. Explain the types of languages and symbols used in communication.
4. Define and explain the technical terms and concepts used to describe the principles, mechanisms, and systems associated with energy, power, instrumentation & control and electricity/electronics technology.
5. Describe the interface between communication and energy & power technology.
6. Describe the interface between communication and materials & processing technology.
7. Provide examples of the positive and negative impacts of communication technology's impacts on society in economic, environmental, psychological and sociological terms.
8. Demonstrate the safe and proper use of communication technology tools, equipment, materials and processes.
9. Apply the basic scientific foundations of chemistry, physics and mathematics to explain the operation of key communication technology processes.
10. Explain the photo-chemistry involved in silver-halide photography.
11. Describe the relationships between light's properties and its behavior in typical communication applications.
12. Perform calculations and conversion operations using binary and hexa-decimal number systems.
13. Calculate the scaling of photographic enlargements/reductions.
14. Trace the historical development of major communication systems.

2. Technological Procedures--The student will be able to:

1. Use commercial information accessing/retrieval/storage mechanisms; such as Sweets, Mitchells Manuals, microform parts lists, computer data bases and the like. . .) to locate, secure and refile needed technological information.
2. Take a technological system and develop a detailed list of its major building blocks, system and building block inputs, system and building block outputs, statement of system goal, feedback mechanism, and sketch its configuration.
3. Design a technological system, using existing and/or newly developed components and/or building blocks, to meet an assigned set of design specifications.
4. Process technological information using data analysis and data reduction methods such as computer or manual statistical process control procedures.
5. Report technological information using graphic, chart, tabular and textual presentations in printed, media or electronic forms.
6. Employ individual and group problem-solving processes to arrive at alternative solutions, to assess and subsequently to implement solutions to assigned technological problems.
7. Conduct technology assessment studies to evaluate the impacts and benefits of a specific technology or technological solution.
8. Describe the major categories of use of computers in industry.
9. Use a selected computer language to perform a basic industrial function.
10. Use selected types of computer input/output devices.
11. Identify components of a typical computer; input, memory, output, and central processing unit.
12. Describe the operation of a computer.
13. Define the technical terms associated with computer technology.
14. Identify assets and limitations of computers.
15. Describe how computers are interfaced with other machines to operate processes.
16. Use a computer language to write a useable program.
17. Identify and describe important applications and uses of the computer in education, industry, business, or government.
18. Identify applications of the computer for entertainment and communication.

19. Assess the effects that computers have made and will make on society, human needs, environment and values.
20. Describe in sequence the steps used in research & development.

3. Communication Technology Fundamentals--The student will be able to:

1. Modify images using a variety of appropriate image processing methods.
2. Secure and evaluate feedback to assess the effectiveness of a communication method.
3. Communicate information using major types of transmission methods such as light, audio, electrical, electronic, graphic and tactile.
4. Produce and/or secure information to be communicated by using a variety of idea generation processes.
5. Employ selected communication reception/decoding mechanisms.
6. Produce images using a variety of image generation procedures including drafting, photography, graphic arts and the computer.
7. Store information using graphic, photographic and electronic methods.
8. Transfer information using computer data communications.
9. Identify and describe the equipment and materials used to transmit, receive, and store messages via computers.
10. Describe new and evolving computer components and capabilities.

4. Engineering Graphics & Design Fundamentals--The student will be able to:

1. Employ conventional drafting techniques to produce competent drawings that meet appropriate standards and reproduction requirements.
2. Employ CAD techniques and equipment to produce drawings or other output that meets appropriate standards.
3. Use architectural drafting procedures to produce construction-related drawings such as floor plans, elevations, foundation plans, plot plans, wall sections and details.
4. Use mechanical drafting procedures to produce production-related drawings.
5. Employ a systematic design process to produce a product that meets the assigned design specifications.
6. Read technical and working drawings and prints to secure needed information.
7. Use a variety of sketching techniques to graphically communicate information informally.
8. Describe the basic instruments and equipment used in drafting.
9. Apply accepted lettering practices and styles.
10. Describe and properly employ the relationship between points, lines, and planes through multiview drawing principles.
11. Describe objects through various pictorial development techniques.
12. Apply the concepts of residential building design and technical drafting in producing a home design.
13. Evaluate the quality of current drafting products from tracings to presentation drawings.
14. Utilize resource and reference materials essential to major design-drafting areas.
15. Describe the operation and application of computer-aided design and drafting in industry.
16. Explore rendering and technical illustration techniques using freehand sketching, pencil shading, ink wash, and watercolor to produce presentation drawings.
17. Use symbols, lettering and building standards as published by the American Institute of Architects.
18. Apply energy conservation practices in the design of structures and utility systems.
19. Incorporate safety and security measures into building designs.
20. Differentiate between residential/commercial and light/heavy construction.
21. Describe major projection systems and their spatial relationships.
22. Develop problem solving techniques related to graphical solutions to engineering problems.
23. Select appropriate drafting conventions to describe object shapes.
24. Apply descriptive geometry principles in developing revolution, auxiliary and successive auxiliary drawings.
25. Produce working drawings of single and multipart mechanical devices.
26. Demonstrate the production of axonometric, oblique, and perspective drawings.
27. Apply the principles of size description relating to tolerance and precision dimensioning.
28. Employ standard thread and fastener notation in appropriate drawings.
29. Reproduce technical drawings using conventional and electronic processes.

5. Graphic Communications (Print) Fundamentals--The student will be able to:

1. Employ basic and specialized graphic arts techniques to produce graphic products that meet appropriate needs and standards.
2. Develop advanced problem solving and creative abilities involving the materials, equipment, processes, and products of the graphic arts industry.
3. Exhibit positive work habits and attitudes as they relate to the safe and skillful operation of graphic communication tools and equipment.
4. Define the major elements in the production of graphic products and services; including design of the product, its composition , purchasing materials, materials, production/processing, binding and finishing and delivery of the final product.
5. Analyze and explain the roles of management and labor as they relate to graphic arts technology.
6. Identify the major types of materials and supplies used in graphic arts technology.
7. Identify and describe the essential features of the equipment used in graphic arts technology.
8. Demonstrate the safe use of equipment, supplies, materials, and processes that are related to graphic arts technology.
9. Estimate job production costs and requirements.
10. Analyze processes and techniques by combining, contrasting, and evaluating printing problems as they relate to graphic arts technology.
11. Discuss technical aspects of graphic arts technology with other students.
12. Employ a variety of printing processes in the production of multiple products.
13. Use a variety of finishing and/or binding processes to complete the production of graphic products.
14. Evaluate a printed product in terms of its effectiveness as a communication.

6. Photographic Communication Fundamentals--The student will be able to:

1. Produce continuous tone black & white photographic products.
2. Expose photographic film with a variety of cameras.
3. Make enlargements of photographic negatives and positives.
4. Measure light and calculate exposures for photographic equipment and materials.
5. Process photographic film and prints in standard ways.
6. Produce line copy positives and negatives.
7. Develop color photographic products, such as slides.
8. Explain color theory.
9. Describe the process of color reproduction.
10. Identify the major considerations in the purchase of photographic supplies, materials and equipment.
11. Develop a "shooting" script.
12. Develop visual communication presentations using color slides and prints.

7. Electronic Communication Fundamentals--The student will be able to:

1. Employ radio communication to send and receive messages.
2. Use computer communication programs, modems and telephone lines to interact with bulletin boards and electronic mail/messaging systems.
3. Transfer information directly between two computers.
4. Merge textual and graphic information.
5. Generate graphics using computer programs.
6. Use digitizing cameras, tablets or other input hardware to produce electronic images.
7. Transfer information optically using light beams and/or fiber optics, lasers or simulators.

8. Communication Technology Applications--The student will be able to:

1. Produce radio and/or television shows.
2. Record, audio or video productions.
3. Edit audio and/or video productions.
4. Produce newsletters or periodicals using conventional or electronic means.
5. Employ desktop publishing in the production of a product.
6. Operate video-tape recorders and cameras.
7. Describe the process of satellite communication.
8. Explain the steps and technology involved in major American applications of communication technology.
9. Give examples of the positive and negative impacts of broadcasting.
10. Identify the impacts that cable, satellite communication, and interactive data have had on society and the effects that they can and will have in the future.
11. Explain the fundamental characteristics, roles, structure, and organization of radio and TV productions.
12. Demonstrate the safe use of equipment, tools, materials and processes that are related to electronic communication.
13. Explain the process of microwave communication.
14. Identify and describe resources utilized to transmit graphic and electronic messages.
15. Define terms associated with high technology telecommunications like satellites, lasers, holography, and magnetic bubbles.
16. Experiment with processes, equipment, and materials to develop insight into new and advancing technologies.
17. Assess applications of telecommunication technology for information and entertainment.
18. Identify uses of communication technology for energy utilization, production, and transportation.
19. Solve hypothetical industrial communication problems through problem solving, creative thinking, and decision making processes.

9. Careers in Communication Technology--The student will be able to:

1. Assess his/her personal characteristics, talents and interests as they relate to a career in communication technology.
2. Identify and classify occupations in the communication technology industry.
3. Identify and describe career and technological trends in communication technology.
4. Differentiate among various career roles, levels and functions in communication technology.
5. Identify preparatory routes that lead to tentative career choices.
6. Research and describe occupational prospects of various communication technology occupations.
7. Demonstrate appropriate employability skills in job identification, seeking and application.
8. Demonstrate personal characteristics; interpersonal relations, dependability, work attitude, communication ability, personal hygiene/grooming; appropriate to employability.
9. Describe the potential for entrepreneurial activity in communication technology.
10. Demonstrate informed and meaningful occupational and educational choices.
11. Express a positive self-concept attitude regarding equipment, productive effort, and safety for him/her-self and others.
12. Explore career choices in engineering and related technological areas.

10. Leadership Roles in Technology--The student will be able to:

1. Demonstrate leadership in individual activity related to the course.
2. Employ leadership skills in performing officer duties and guiding student organization activity.
3. Work cooperatively with others in leadership and followership roles.
4. Describe the purposes of student organization activity.
5. Bring group activity to a successful conclusion.
6. Participate effectively in local, state, and national clubs.

INTRODUCTION TO ENERGY & POWER TECHNOLOGY

Suggested Major Units of Instruction: Introduction to Energy & Power Technology

1. Energy & Power Technology Overview
2. Technological Procedures
3. Energy Technology Fundamentals
4. Power Technology Fundamentals
5. Electricity/Electronics Fundamentals
6. Instrumentation & Control Technology Fundamentals
7. Energy & Power Technology Applications
8. Careers in Energy & Power Technology
9. Leadership Roles in Technology

Suggested Content Outline: Introduction to Energy & Power Technology

1. Energy & Power Technology Overview
    - Energy & Power Systems
    - Components of Energy & Power Technology Systems
    - Interface to Communication Technology
    - Interface to Materials & Processing Technology
    - Energy & Power Technology Impacts
        - Economic
        - Environmental
        - Psychological
        - Sociological
    - Safety
    - Scientific Foundations of Energy & Power Technology
        - Chemistry
        - Physics
        - Math
        - Basic Machines

2. Technological Procedures
    - Information Accessing/Retrieval/Storage
    - Information Processing
    - Information Reporting
    - Problem-solving Processes
    - Systems Analysis & Design
    - Technology Assessment

3. Energy Technology Fundamentals
    - Measurement
    - Energy Sources
        - Chemical
        - Mechanical/Kinetic
        - Radiant
        - Electrical
        - Thermal
        - Nuclear
    - Energy Conversions
    - Renewable/Non-renewable
    - Alternative Energy Systems

4. Power Technology Fundamentals
    - Types of Power Transmission
        - Pneumatic
        - Hydraulic
        - Mechanical
        - Electrical
    - Measurement
    - Power Conversion

5. Electricity/Electronics Fundamentals
    - Electricity Fundamentals
    - Electronic Fundamentals
    - Electricity/Electronics Components
    - Circuits
    - Electricity/Electronics Measurement

6. Instrumentation & Control Technology Fundamentals
    - Components
        - Computers
        - Sensors
        - Transducers
        - Regulators
        - Indicators
    - Types of Instrumentation & Control Systems
        - Fluid
        - Optical
        - Mechanical
        - Electrical
        - Electronic
        - Electro/Mechanical

7. Energy & Power Technology Applications
    - Robots
    - Materials Handling
    - Transportation
        - Terrestrial
        - Air
        - Water
        - Space
    - Equipment Operation
    - Engines
    - Power Distribution
    - Servicing

8. Careers in Energy & Power Technology
    - Personal Assessment
    - Career and Technological Trends
        - Manufacturing
        - Service
        - Sales
    - Employability Skills

9. Leadership Roles in Technology
    - Individual Leadership
    - Group Leadership
    - Student Organization Activities

Suggested Competencies: Introduction to Energy & Power Technology

1. **Energy & Power Technology Overview--The student will be able to:**

    1. Identify and illustrate the components of energy & power technology.
    2. Describe and illustrate examples of the major types of energy conversion systems, their components and key variables.
    3. Describe and illustrate examples of power systems, their components and key variables.
    4. Describe and illustrate examples of instrumentation & control systems, their components and key variables.
    5. Describe the interface between energy & power technology and communication technology.
    6. Describe the interface between energy & power technology and materials & processing technology.
    7. Provide examples of the positive and negative impacts of energy & power technology's impacts on society in economic, environmental, psychological and sociological terms.
    8. Demonstrate the safe and proper use of energy & power technology tools, equipment, materials and processes.
    9. Apply the basic scientific foundations of chemistry, physics and mathematics to explain the operation of key energy & power technology processes.
    10. Explain the chemistry involved in key energy conversion processes such as combustion.
    11. Use the physical principles of simple machines to explain the operation of power transmission systems.
    12. Perform calculations and conversion operations using binary and hexa-decimal number systems.
    13. Employ exponents to facilitate mathematical calculations.
    14. Define and explain the technical terms and concepts used to describe the principles, mechanisms, and systems associated with energy, power, instrumentation & control and electricity/electronics technology and their applications such as transportation systems.
    15. Apply hand, mechanized, and automated processes of energy, power, instrumentation & control and electricity/electronics technology through exploratory experiences and laboratory activities.
    16. Define and explain the technical terms and concepts used to describe the principles, mechanisms, and systems associated with selected applications of energy & power technology such as transportation systems.
    17. Trace the historical development of major energy & power systems.

2. **Technological Procedures--The student will be able to:**

    1. Use commercial information accessing/retrieval/storage mechanisms; such as Sweets, Mitchells Manuals, microform parts lists, computer data bases and the like. . .) to locate, secure and refile needed technological information.
    2. Take a technological system and develop a detailed list of its major building blocks, system and building block inputs, system and building block outputs, statement of system goal, feedback mechanism, and sketch its configuration.
    3. Design a technological system, using existing and/or newly developed components and/or building blocks, to meet an assigned set of design specifications.
    4. Process technological information using data analysis and data reduction methods such as computer or manual statistical process control procedures.
    5. Report technological information using graphic, chart, tabular and textual presentations in printed, media or electronic forms.
    6. Employ individual and group problem-solving processes to arrive at alternative solutions, to assess them and subsequently to implement solutions to assigned technological problems.
    7. Conduct technology assessment studies to evaluate the impacts and benefits of a specific technology or technological solution.
    8. Describe the major categories of use of computers in industry.
    9. Use a selected computer language to perform a basic industrial function.
    10. Use selected types of computer input/output devices.
    11. Identify components of a typical computer; input, memory, output, and central processing unit.
    12. Describe the operation of a computer.
    13. Define the technical terms associated with computer technology.

14. Identify assets and limitations of computers.
15. Describe how computers are interfaced with other machines to operate processes.
16. Use a computer language to write a useable program.
17. Identify and describe important applications and uses of the computer in education, industry, business, or government.
18. Assess the effects that computers have made and will make on society, human needs, environment and values.
19. Describe in sequence the steps used in research & development.
20. Use electronic means of data acquisition to collect information about the operation of systems.
21. Use a variety of sketching techniques to graphically communicate energy & power technology system information.

3. Energy Technology Fundamentals--The student will be able to:

1. Describe the characteristics of major energy sources; chemical, mechanical/kinetic, radiant, electrical, thermal, nuclear.
2. Explain the energy conversion process, and the necessary apparatus, between any two energy sources.
3. Secure and evaluate feedback to assess the effectiveness of an energy conversion method.
4. Describe alternative energy systems based on each major energy source.
5. Identify renewable and non-renewable energy sources in the world, in the U.S.A., and in Missouri.
6. Build experimental/prototype energy conversion demonstrators and measure their effectiveness.
7. Define the units (customary and metric) used in measuring energy and make conversions among them.
8. Use laboratory equipment to measure energy conversion variables such as fuel efficiency, heat loss and the like. . .
9. Define common terms related to the study and use of energy.
10. Transfer information using computer data communications.
11. Identify and describe the equipment and materials used to transmit, receive, and store messages via computers.
12. Chart the basic trends of energy use and growth patterns.
13. Define efficiency in energy conversion terms.
14. Describe major physical and social problems and possible solutions concerning alternate energy sources.
15. Debate the advantages and disadvantages of nuclear generation of electricity.
16. Describe and illustrate the basic concepts of storage, transmission and control of various forms of energy.
17. Contrast the basic concepts of coal, petroleum, natural gas and other fossil fuel utilization.
18. Identify the status, availability, significance, economic and environment advantages and disadvantages of various alternative energy systems e.g., solar, wind. . . , in your community/region.
19. Explain the First Law of Thermodynamics (Law of Energy Conservation) and illustrate its application in key energy processes.
20. Describe the Second Law of Thermodynamics (Diminishing of available of energy) and how it relates to closed energy systems.
21. Recognize and respond to the need for energy conservation (electrical, water, fossil fuels) in residential, commercial, industrial, and transportation applications.
22. Identify and evaluate the merits of various energy conservation measures for a home/industry.
23. Differentiate between, and sketch the operation of, internal and external combustion engines.
24. Describe the basic principles and applications of nuclear power.
25. Describe the principles of operation and list the various components of two-cycle/four-cycle engines.
26. Describe the basic principles of operation for rotary combustion engines.
27. Describe the basic principles of operation for diesel engines.
28. Describe the basic principles of operation for jet and rocket engines.
29. Define the basic principles of piston and turbine use of steam power.
30. Demonstrate the principles of heat transfer using common laboratory equipment.
31. Measure internal combustion engine performance utilizing a variety of test instruments.

4. Power Technology Fundamentals--The student will be able to:

1. Describe the characteristics and advantages/disadvantages of each major type of power transmission system; pneumatic, hydraulic, mechanical, electrical.
2. Develop an operational definition and concept of power systems.
3. Define the basic terms commonly used in power systems.
4. Describe the types of power systems used in our society.
5. Illustrate and explain the six simple machines and their applications.
6. Describe the internal combustion engine's importance in transportation and industry.
7. Employ a systematic design process to produce a power transmission system that meets the assigned design specifications.
8. Explain lubrication systems, their function and importance in power technology.
9. Read technical and working drawings and prints to secure needed information.
10. Explain the principles of motor operation.
11. Select motors to suit the characteristics of the application.
12. Describe the basic instruments and equipment used in power transmission.
13. Build demonstrator power conversion and transmission devices.
14. Explain the basic concepts of mechanical transmission devices.
15. Describe the applications of pneumatics in a technological society.
16. Describe the applications of hydraulics in a technological society.
17. Construct fluid power systems utilizing typical components.
18. Manipulate common test instruments to analyze fluid power circuits.
19. Use tools and equipment to assemble mechanical power transmission systems and mechanisms.
20. Use computers to monitor and control power transmission systems.

5. Electricity/Electronics Fundamentals--The student will be able to:

1. Develop problem solving and creative abilities involving the materials, equipment, processes, and products of electricity/electronics technology.
2. Define basic electrical terminology and units of measure.
3. Demonstrate the safe use of equipment, supplies, materials, and processes that are related to electricity/electronic technology.
4. Exhibit positive work habits and attitudes as they relate to the safe and skillful operation of electric/electronic tools and equipment.
5. Explain and demonstrate the principles of static electricity and dynamic electricity.
6. Identify and define the sources of electricity.
7. Identify the major types of materials and supplies used in electricity/electronic technology.
8. Identify and describe the essential features of the equipment used in electricity/electronic technology.
9. Explain basic electron theory and its application to electricity/electronics.
10. Identify and describe the major electrical and electronic components used in conventional applications.
11. Use electronic components to build temporary and/or permanent circuits.
12. Describe the principles of magnetism and electromagnetism.
13. Define basic storage systems for static and dynamic electricity.
14. Describe the problems of high voltage distribution.
15. Differentiate between alternating and direct current and demonstrate the differences.
16. Describe the basic concept of solid state circuitry.
17. Construct basic power supplies and describe their operation.
18. Assemble basic audio amplifiers and describe their operation and purposes.
19. Explain the construction and use of integrated circuits.
20. Relate the impact of electricity/electronics on our society.
21. Explain basic electrical laws and use them to solve assigned problems.
22. Operate basic electrical/electronic test instruments and equipment such as ammeters, voltmeters, ohmmeters, multimeters, oscilloscopes and the like.
23. Connect series, parallel and series-parallel circuits.
24. Identify and use electrical and electronic symbols.

25. Draw and read basic electrical schematic diagrams.
26. Describe the electrical supplies/materials for residential wiring, commercial wiring, and industrial machine wiring.
27. Identify key features of residential electrical codes.
28. Install electric motors and controls.
29. Perform basic mathematical calculations in the quantitative solution of electrical/electronic problems.
30. Interpret logic diagrams.
31. Explain systematic and safe procedure in setting up experimental circuits and servicing equipment.
32. Differentiate between digital and analog circuits and components.

6. Instrumentation & Control Technology Fundamentals--The student will be able to:

1. Identify and describe the major components of instrumentation & control systems such as; sensors, transducers, regulators, final control elements, regulators, indicators and computers.
2. Select appropriate instrumentation based on the information to be communicated.
3. Sketch the configuration of instrumentation & control systems designed to meet assigned needs.
4. Differentiate among the types of instrumentation & control systems; fluid, optical, mechanical, electrical, electronic, and electro-mechanical: and identify appropriate applications of each.
5. Use the computer to control systems.
6. Display system operation information on the computer.
7. Explain the concepts of positive and negative feedback.
8. Develop and install instrumentation & control systems on laboratory energy & power systems.

7. Energy & Power Technology Applications--The student will be able to:

1. Demonstrate the safe use of equipment, tools, materials and processes that are related to energy and power technology.
2. State how robots are examples of energy and power technology as well as materials handling technology.
3. Construct robots that apply energy and power technology in a controlled manner.
4. Analyze industrial equipment operation in terms of energy conversion, power transmission, and instrumentation & control systems.
5. Compare and contrast the advantages and disadvantages of various forms of engines for particular applications.
6. Describe examples of large scale power distribution systems.
7. Identify the key categories of service involved in maintaining energy & power equipment.
8. Describe the evolution of various types of transportation systems such as terrestrial, air, water and space.
9. State the advantages and limitations of various modes of material and/or people transportation systems such as railroads, automobiles, robots, mass transit, pipelines, . . .
10. Transfer information directly between two computers.
11. Describe the functions of transportation systems in the movement of goods and people.
12. Describe the components of transportation systems.
13. Summarize rules and regulations which control transportation.
14. Project alternative futures for current transportation system.
15. Read and interpret transportation system maps, charts, and schedules.
16. Explain the support systems which serve the transportation enterprise.
17. Describe the safety aspects of transporting goods and people.
18. Describe the major developments and steps that enabled space transportation.
19. Explain the pollution problems posed by the use of various transportation systems.
20. Identify the applications of energy and power technology in the propulsion, payload and guidance systems used in spacecrafts.
21. Demonstrate proper safety precautions in working with model rockets.
22. Experiment with processes, equipment, and materials to develop insight into new and advancing energy & power technologies.

8. Careers in Energy & Power Technology--The student will be able to:

1. Assess his/her personal characteristics, talents and interests as they relate to a career in energy & power technology.
2. Identify and classify occupations in the energy & power technology industry.
3. Identify and describe career and technological trends in energy & power technology.
4. Differentiate among various career roles, levels and functions in energy & power technology.
5. Identify preparatory routes that lead to tentative career choices.
6. Research and describe occupational prospects of various energy & power technology occupations.
7. Demonstrate appropriate employability skills in job identification, seeking and application.
8. Demonstrate personal characteristics; interpersonal relations, dependability, work attitude, communication ability, personal hygiene/grooming; appropriate to employability.
9. Describe the potential for entrepreneurial activity in energy & power technology.
10. Demonstrate informed and meaningful occupational and educational choices.
11. Express a positive self-concept and attitude regarding equipment, productive effort, and safety for him/her-self and others.
12. Explore career choices in engineering and related technological areas.

9. Leadership Roles in Technology--The student will be able to:

1. Demonstrate leadership in individual activity related to the course.
2. Employ leadership skills in performing officer duties and guiding student organization activity.
3. Work cooperatively with others in leadership and followership roles.
4. Describe the purposes of student organization activity.
5. Bring group activity to a successful conclusion.
6. Participate effectively in local, state, and national clubs.

INTRODUCTION TO MATERIALS & PROCESSING TECHNOLOGY

Suggested Major Units of Instruction: Introductio[illegible]o Materials & Processing Technology

1. Materials & Processing Technology Overview
2. Technological Procedures
3. Materials Technology Fundamentals
4. Construction Technology Fundamentals
5. Production Technology Fundamentals
6. Materials & Processing Technology Applications
7. Careers in Materials & Processing Technology
8. Leadership Roles in Technology

Suggested Content Outline: Introduction to Materials & Processing Technology

1. Materials & Processing Technology Overview
   - Materials & Processing Systems
   - Components of Materials & Processing Systems
     - Materials
     - Manufacturing
     - Construction
   - Interface to Communication Technology
   - Interface to Energy & Power Technology
   - Materials & Processing Technology Impacts
     - Economic

    - Psychological
    - Sociological
    - Environmental
  - Types of Materials & Processing Production
    - Artistic
    - Individual
    - Job
    - Mass
    - Continuous
  - Safety
  - Scientific Foundations of Materials & Processing Technology
    - Chemistry
    - Physics
    - Math

2. Technological Procedures
   - Information Accessing/Retrieval/Storage
   - Information Processing
   - Information Reporting
   - Problem-solving Processes
   - Systems Analysis & Designs
   - Technology Assessment

3. Materials Technology Fundamentals
   - Properties & Characteristics
   - Destructive Testing
   - Non-destructive Testing
   - Inspection and Measurement
   - Classification of Materials
     - Organic -- (Adhesives, woods, paper, plastic, rubber. . .)
     - Metallic -- (Ferrous, non-ferrous. . .)
     - Synthetic -- (Plastics, composites. . .)
     - Ceramic -- (Glass, abrasives, cements/concretes. . .)

4. Construction Technology Fundamentals
   - Types of Construction
   - Site Preparation
   - Types of Structures
   - Construction Methods
   - Erection
   - Materials
   - Servicing

5. Production Technology Fundamentals
   - Tools & Machines
   - Tooling
   - Processing
     - Separating
     - Combining
     - Forming
     - Conditioning
   - Pre-processing/Extraction
   - Post-processing/servicing
   - Labor Relations
   - Management
   - Financing/Enterprise
   - Marketing
   - Research & Development

6. Materials & Processing Technology Applications
    - Residential Construction
    - Mass Production
    - Craft Production
    - Quality Control

7. Careers in Materials & Processing Technology
    - Personal Assessment
    - Career and Technological Trends
        - Manufacturing/Construction
        - Service
        - Sales
    - Employability Skills

8. Leadership Roles in Technology
    - Individual Leadership
    - Group Leadership
    - Student Organization Activities

Suggested Competencies: Introduction to Materials & Processing Technology

1. **Materials & Processing Technology Overview--The student will be able to:**

    1. Describe and illustrate major materials processing processes, their components and their key variables.
    2. Describe the categories of materials and their primary characteristics.
    3. Provide examples of the major types of materials processing systems (individual, artistic, mass, continuous).
    4. Define and explain the technical terms and concepts used to describe the principles, mechanisms, and systems associated with materials & processing technology.
    5. Describe the interface between materials & processing and energy & power technology.
    6. Describe the interface between materials & processing and communication technology.
    7. Describe the relationship of materials processing technology to manufacturing systems.
    8. Describe the relationship of materials processing technology to construction systems.
    9. Provide examples of the positive and negative impacts of materials & processing technology's impacts on society in economic, environmental, psychological and sociological terms.
    10. Demonstrate the safe and proper use of materials & processing technology tools, equipment, materials and processes to manufacture and construct products.
    11. Apply the basic scientific foundations of chemistry, physics and mathematics to explain the operation of key materials & processing technology processes.
    12. Explain selected chemical concepts involved in the processing of metals, plastics, ceramics and cellulose materials.
    13. Explain selected physics concepts involved in the processing of metals, plastics, ceramics and cellulose materials.
    14. Perform calculations and conversion operations pertinent to size, volume, area and density.
    15. Describe cartesian coordinate systems and their application to computerized production processes.
    16. Apply planning, organizing, controlling, producing, and quality control processes to manufacturing and construction projects.
    17. Trace the historical development of major energy & power systems.

2. Technological Procedures--The student will be able to:

1. Use commercial information accessing/retrieval/storage mechanisms; such as Sweets, Mitchells Manuals, microform parts lists, computer data bases and the like. . .) to locate, secure and refile needed technological information.
2. Take a technological system and develop a detailed list of its major building blocks, system and building block inputs, system and building block outputs, statement of system goal, feedback mechanism, and sketch its configuration.
3. Design a technological system, using existing and/or newly developed components and/or building blocks, to meet an assigned set of design specifications.
4. Process technological information using data analysis and data reduction methods such as computer or manual statistical process control procedures.
5. Report technological information using graphic, chart, tabular and textual presentations in printed, media or electronic forms.
6. Employ individual and group problem-solving processes to arrive at alternative solutions, to assess and subsequently to implement solutions to assigned technological problems.
7. Conduct technology assessment studies to evaluate the impacts and benefits of a specific technology or technological solution.
8. Describe the major categories of use of computers in industry.
9. Use a selected computer language to perform a basic industrial function.
10. Use selected types of computer input/output devices.
11. Identify components of a typical computer; input, memory, output, and central processing unit
12. Describe the operation of a computer.
13. Define the technical terms associated with computer technology.
14. Identify assets and limitations of computers.
15. Describe how computers are interfaced with other machines to operate processes.
16. Use a computer language to write a useable program.
17. Identify and describe important applications and uses of the computer in education, industry, business, or government.
18. Assess the effects that computers have made and will make on society, human needs, environment and values.
19. Describe in sequence the steps used in research & development.

3. Materials Technology Fundamentals--The student will be able to:

1. Process a variety of appropriate metallic, plastic, ceramic and cellulose materials using separating, combining, forming and conditioning methods.
2. Exhibit positive work habits and attitudes as they relate to the safe and skillful use of materials.
3. Secure and evaluate feedback to assess the effectiveness of a materials processing method.
4. Test materials to identify their characteristics and properties.
5. Describe and give examples of the categories of materials properties and characteristics.
6. Identify the range of materials in each major category; Organic -- (Adhesives, woods, paper, plastic, rubber...), Metallic -- (Ferrous, non-ferrous. . .), Synthetic -- (Plastics, composites. . .), Ceramic -- (Glass, abrasives, cements/concretes).
7. Locate commercial data describing standard industrial stock in each category of material.
8. List important quality characteristics necessary for the informed purchase and use of selected materials in each major category.
9. Identify and describe the equipment and materials used in materials testing.
10. Employ destructive methods to identify major characteristics and properties of materials.
11. Employ non-destructive methods to identify major characteristics and properties of materials.
12. Inspect materials and products using precision techniques.
13. Provide some key examples of the relationship between molecular/crystalline structure of materials and their properties.
14. Trace the path of materials; e.g. woods, iron, synthetics, glass) from their extraction/harvesting, through their processing into industrial standard stock, to the finished product.
15. Describe standard industrial conditioning processes applied to materials, e.g. kiln drying, heat treating, preserving and the like.

4. Construction Technology Fundamentals--The student will be able to:

1. Use architectural drafting procedures to produce construction-related drawings such as floor plans, elevations, foundation plans, plot plans, wall sections and details.
2. Apply the concepts of residential building design and technical drafting in producing a home design.
3. Identify structural needs for light commercial buildings.
4. Differentiate between the elements of custom detailing and modular construction.
5. Use symbols, lettering and building standards as published by the American Institute of Architects.
6. Identify types of construction.
7. Apply energy conservation practices in the design of structures and utility systems.
8. Incorporate safety and security measures into building designs.
9. Differentiate between residential/commercial and light/heavy construction.
10. Analyze and explain the roles of management and labor as they relate to construction technology.
11. Participate in the planning, organizing, controlling, producing, and quality control of construction processes.
12. Identify the major types of materials and supplies used in construction technology.
13. Identify and describe the essential features of the equipment used in construction technology.
14. Demonstrate the safe use of equipment, supplies, materials, and processes that are related to construction technology.
15. Estimate construction job costs and requirements.
16. Apply maintenance and servicing techniques to structures.
17. Describe some key construction documents and legal requirements.
18. Identify light, heavy, industrial, and civil construction processes and techniques including site preparation.
19. Investigate and report on emerging tools, materials, and processes in the construction industry.
20. Investigate the use of robots in manufactured construction techniques.
21. Discuss the methods of buying and selling real estate.
22. Describe manufactured construction techniques.
23. Demonstrate basic construction knowledge and skills.
24. Describe the necessary characteristics of utility systems used in light construction.
25. Experiment with simulated foundations to identify their load bearing characteristics.
26. Make sample utility (plumbing, electrical, climate control) installations on demonstrator installations.
27. Design and schedule landscaping projects.
28. Plan, design, layout and build a scale model of a model community.

5. Production Technology Fundamentals--The student will be able to:

1. Apply hand, mechanized, and automated processes in the production of a product.
2. Analyze and explain the roles of management and labor as they relate to production technology.
3. Identify the major types of materials and supplies used in production technology.
4. Identify and describe the essential features of the equipment used in production technology.
5. Demonstrate the safe use of tools, equipment, materials, and processes that are related to production technology.
6. Estimate job production costs and requirements.
7. Employ conventional drafting techniques to produce competent production drawings that meet appropriate standards.
8. Employ CAD techniques and equipment to produce drawings or other output that meets appropriate standards.
9. Use mechanical drafting procedures to produce production-related drawings.
10. Employ a systematic design process to produce a product that meets the assigned design specifications.
11. Read technical and working drawings and prints to secure needed information.
12. Discuss the interrelationships between management, personnel, labor and production practices.
13. Prepare a complete bill of materials from a working drawing.
14. Select and apply the appropriate use of fasteners in products.
15. Name and describe major types of adhesives citing the advantages and disadvantages of each.

16. List and follow safe practice in using the hand tools and power equipment of the production industry.
17. Describe various abrasives citing the advantages and disadvantages of each.
18. Describe various finishing materials, citing the advantages, disadvantages, characteristics, and purposes of each, and demonstrate their correct application procedure.
19. Describe the activities of a design department in manufacturing industries.
20. Solve simulated industrial design or planning problems in the production of a product.
21. Evaluate manufactured products in terms of appropriateness of material, functionality of design and purpose as well as quality of construction.
22. Devise a plan of procedures and operations for repetitive and quantity fabrication of products or components.
23. Investigate and analyze various material industries' impact on the ecological balance, the utilization and conservation of natural resources, and the recycling of materials and goods.
24. Explain the industrial processes employed to separate, combine, condition, form and fabricate materials into functional items.
25. Discuss production technology breakthroughs and future trends in industry.
26. Discuss environmental problems and recycling technology as they relate to production technology.
27. Participate in establishing, financing, planning, organizing, controlling, production and quality control of simulated mass production/manufacturing enterprises.
28. Describe the activities of a research and development department in bringing out a new product.

6. Materials & Processing Technology Applications--The student will be able to:

1. Explain the steps and technology involved in major American applications of materials & processing technology.
2. Give examples of the positive and negative impacts of materials & processing technology.
3. Apply standard industrial quality control procedures to items produced in the laboratory.
4. Explain the fundamental characteristics, roles, structure, and organization of the manufacturing and construction industry.
5. Demonstrate the safe use of equipment, tools, materials and processes that are related to materials & processing technology.
6. Define terms associated with high technology materials & processing technology like CAM, composites, holography, and magnetic bubbles.
7. Experiment with processes, equipment, and materials to develop insight into new and advancing technologies.
8. Solve materials & processing technology problems through problem solving, creative thinking, and decision making processes.
9. Apply maintenance and servicing techniques to goods and structures.
10. Place manufacturing and construction technology in the broad context of industrial technology.
11. Relate the activities of manufacturing and construction technology to local, state, and national developments.

7. Careers in Materials & Processing Technology--The student will be able to:

1. Assess his/her personal characteristics, talents and interests as they relate to a career in materials & processing technology.
2. Identify and classify occupations in the materials & processing technology industry.
3. Identify and describe career and technological trends in materials & processing technology.
4. Differentiate among various career roles, levels and functions in materials & processing technology.
5. Identify preparatory routes that lead to tentative career choices.
6. Research and describe occupational prospects of various materials & processing technology occupations.
7. Demonstrate appropriate employability skills in job identification, seeking and application.
8. Demonstrate personal characteristics; interpersonal relations, dependability, work attitude, communication ability, personal hygiene/grooming; appropriate to employability.
9. Describe the potential for entrepreneurial activity in materials & processing technology.
10. Demonstrate informed and meaningful occupational and educational choices.

11. Express a positive self-concept and attitude regarding equipment, productive effort, and safety for him/her-self and others.
12. Explore career choices in engineering and related technological areas.

8. Leadership Roles in Technology--The student will be able to:

1. Demonstrate leadership in individual activity related to the course.
2. Employ leadership skills in performing officer duties and guiding student organization activity.
3. Work cooperatively with others in leadership and followership roles.
4. Describe the purposes of student organization activity.
5. Bring group activity to a successful conclusion.
6. Participate effectively in local, state, and national clubs.

Notes:

5. MO ITE Guide Suggested Revision Form

To maintain the value of the ITE Guide, members of the profession are encouraged to submit suggestions for additions, revisions and other modifications of any part of this document.

Chapter #: ____ Chapter Name: ______________________________

Part # ________ Part Name: ______________________________

My suggestion is a: ___ Revision ____ Addition ____ Other: ____________________

My suggestion is to: (Attach pages and information as needed)

Mail to:
Missouri Industrial Technology Education Supervisor
Division of Vocational and Adult Education
Missouri Department of Elementary and Secondary Education
P.O. Box 480
Jefferson City, MO 65102